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The Industrial Processes of
Manipulative Activity in the Industrial



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THE INDUSTRIAL PROCESSES AS A BASIS FOR THE
MANIPULATIVE ACTIVITIES IN THE INDUSTRIAL-ARTS SHOP

Submitted by

James Francis Baker
(B.S.E., Fitchburg, 1939)

In partial fulfillment of requirements for
the degree of Master of Education

1946

First Reader: Roy O. Billett, Professor of Education

Second Reader: J. Wendell Yeo, Associate Professor of Education

Third Reader:

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The pupils' progress--In the educational program of our schools we find it essential to adapt the curriculum to the needs of the pupils. It is evident at a glance that we live in a society largely industrial, one of which grow specific industrial needs common to all ages and groups. The division of our curriculum which is best suited to assist the individual in making a wise vocational choice, to suggest worthwhile leisure-time activities, and to provide additional knowledge in the industrial-arts program in the secondary schools.

Connecting industry and education--A major problem confronting the industrial-arts teacher is the selection of material from this industrial society which will be of prime importance to the student. A proper connecting of education and industry will best be brought about by the proper selection of information and activities most common to industry; these activities to be taught or better still experienced in the schools. These experiences must be valuable to the industrial worker and consumer and it is true that we can all be classified in one or both of these categories.

CHAPTER I

APPROACHING THE INDUSTRIAL PROCESSES

The Problem

The pupils' needs--In the educational program of our schools, we find it essential to adapt the curriculum to the needs of the pupils. It is evident at a glance that we live in a society largely industrial, out of which grow specific industrial needs common to all ages and groups. The division of our curriculum which is best suited to assist the individual in making a wise vocational choice, to suggest worth-while leisure-time activities, and to provide consumer knowledge is the industrial-arts program in the secondary schools.

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An article by Wiley A. Miller^{1/} emphasizes the importance of industrial visits and the need for co-operation between education and industry for their mutual guidance and growth. A co-operation between education and industry cannot help being beneficial to society for these reasons:

If industry is utilizing certain human values, it will be interested in considering and safeguarding them. If it is providing opportunities for personal growth, it will approve suggestions from educators showing how it can be made a certainty. If industry is placing new and dangerous power in our hands, it will welcome from our schools indications for controlling it. If industry is changing our environment with a rapidity that is baffling, it will appreciate the alertness of our schools in pointing out means for quick adjustment. If industry is needing men of tact, persistence, honesty, co-operative ability, and character, then any means of developing and measuring these characteristics will help industry as well as enrich society. If industry and business can be the means of increasing the dignity and value of life, they would like to strengthen any contacts that will bring realization.

These and countless other problems are demanding a better type of co-operation, a finer co-ordination, a closer linking of industry and education.

The area of the study--So broad is the expanse of this industrial activity that we must first break down or divide it into areas which will lend themselves to analysis or specific study. A suggested five-way division, which was developed by Professor James J. Hammond, of the State Teachers College at Fitchburg, Massachusetts, is into the areas of tools, materials, processes, design, and power.

^{1/} Wiley A. Miller, "Linking Education and Industry," Vocational Guidance Magazine (May 1933), pp. 346-347.

Hardly a single branch of an industry or an industrial product is not affected by or does not contain all of these areas. Few products which are common in our daily living lack or are not influenced by these areas in their construction and development.

Statement of the problem--Each one of these areas contains an endless field for research and study, but for the purpose of developing a specific study concerning the industrial-arts work in the secondary schools, the process area has been chosen as the area for our problem. Many questions arise in our mind concerning the industrial processes. Their nature, importance, development, and subdivision are all thoughts or terms which we encounter while studying the process activities. Before comparison and analysis of a specific process can begin, the major problem must be to develop a list of the most important processes in the major industrial fields which may be used as a basis for the selection of the manipulative activities to be conducted in the school shop program. These processes must contribute to the needs, purposes, and interests of the pupils. They must not be carelessly chosen or of temporary importance but must give a fundamentally sound basis from which to carry on the activities in the industrial-arts laboratory of the school.

No other activities will assist us in achieving our desired goals as well as these process activities. Through

well-planned and well-executed teaching, these processes will:

1. Offer a broad range of exploratory industrial experiences to provide the pupil with knowledges, concepts, attitudes, and ideals concerning industry.
2. Provide a foundation for an occupational choice in a general area of industrial work.
3. Develop elementary manual skill and handy-man abilities with common tools.
4. Provide prevocational skills and training for the student who indicates ability and interest in industrial work.
5. Provide knowledges and skills for hobby and leisure-time activities.
6. Develop an appreciative understanding of work, workers, and their industrial products.
7. Aid in the development of standards of judgment and selection of industrial products and commodities.
8. Develop sound work habits which will be applicable to all areas of work.

The above eight items establish criteria for the analysis and evaluation of the processes to be mentioned.

Importance of the problem as signified by the educational writings--Francis T. Spaulding^{1/} describes the indus-

1/ Francis T. Spaulding, High School and Life; Report of the Regents Inquiry, McGraw-Hill Book Company, Inc. New York 1938, p. 134.

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Francis T. Spaulding, High School and Life: Report of the National Industrial Education Study, McGraw-Hill Book Company, Inc. New York 1933, p. 134.

trial-arts courses now being presented and emphasizes what should be given in the ideal industrial-arts courses. The following is taken from his report:

Ideally, their purpose is to give boys and girls who are interested first hand acquaintance with various simple industrial processes as a means of broadening their understanding of modern occupations and providing them with possible avocational interests. They are not intended to develop vocational skills. Organized in such a way as to allow the pupils to try themselves out in a variety of manipulative processes --work in wood and metal, plastics and stone, textiles and electricity--they may, nevertheless, contribute to effective educational and vocational guidance, and for pupils who eventually go into industrial occupations they may lay the foundation for valuable vocational adaptability. Unfortunately only a few of the industrial-arts courses in New York State high schools are so organized. Many of the present courses are limited to woodworking; they emphasize practice on formal skills more often than an understanding of general processes.

Doctor Spaulding places emphasis on the importance of a variety of processes and would not carry these experiences to the highly skilled or technical development for all pupils. His process list would contain activities which would contribute to broad, exploratory, and foundational experiences. In these foundational activities, he recognizes that many boys may eventually be receiving specific vocational knowledges and training as they progress in their industrial education.

The fact that New York State schools are emphasizing the formal skills in limited activities is not only true of that section of the country but highly indicative of prevalent practices in the majority of industrial-arts curricula

of this day.

Frederick G. Bonser,^{1/} in analyzing the investigative impulse of the child mentions that:

Industrial processes are largely matters of applied science, and the use of the investigative impulses of the children is one of the most potent means toward their growth in interest and understanding of that which is most valuable for the selection and use of industrial supplies and for the intelligent appreciation of the modern industrial world.

Even though the curriculum offerings in this field have been narrow, limited, and vocational, the problem of motivation has been of little concern to the industrial-arts teacher who showed a minimum of effort in the selection of interesting projects or constructive activity. This investigative impulse of the child has been of significant importance in his co-operation and achievement in shop activities. A more careful selection of important and varied activities would tend to satisfy this inborn creative and investigative impulse of the child and return to him a greater reward and satisfaction for the effort which he put forth.

Doctor Bonser,^{2/} in describing the industrial-arts projects, states:

Projects are illustrative of the processes of manufacture. Their design involves a careful study of

1/ Frederick G. Bonser, Industrial Arts for Public School Administrators, Teachers College, Columbia University, New York, N. Y. 1938, p. 13.

2/ Frederick G. Bonser, The Speyer School Curriculum, Teachers College, Columbia University, New York, N. Y. 1913, p. 5.

the principles of design, an examination of designs today, and a study of the designs used by historic peoples. Processes of construction involve, not only hand production, but a study of power machinery, factory production and transportation.

Doctors Snedden and Warner^{1/} mention the adaptability of the processes to industrial-arts laboratory activities either as projects or as small scale industrial experiments which will give a true industrial experience in miniature. Their writings put forth these thoughts:

Numerous processes usually executed on a large scale for commercial purposes can be represented in miniature in school shops. Thus can be introduced as industrial arts: cloth weaving, tanning, gas engine operation, pottery baking, newspaper printing, house building, concrete work, electrical wiring, meat packing, forging, and tool construction.

In these suggested activities one must immediately notice the close relationship which exists between the industrial-arts laboratory and the science laboratory or classroom. A careful analysis of the important processes must be made by both the science and shop teachers to determine the importance of the processes and the adaptability of instruction to either of the two classes.

This close relationship between the industrial processes and the science laboratory is commented on by Harold H. Loudin,^{2/} who has studied the processes in the

1/ David Snedden and William E. Warner, Reconstruction of Industrial Arts Courses, Teachers College, Columbia University, New York, N. Y. 1927, p. 16.

2/ Harold H. Loudin, "Industrial Processes of Local Industry to Vitalize a General Science Course," Science Education (November 1940), Vol. 24, p. 321.

Newark, New Jersey, industries with the thought of applying them to the enrichment of the local science program:

The experiences involved in working out an industrial process in the school science laboratory are of such nature that they should increase the understanding of the learner about Newark industry, should develop an awareness on the part of the pupils regarding other processes, and lastly should lead to more intelligent citizenry in the community.

The recognition that occupational information derived from the school shop activity can be an important contribution to the child's education is evident in the discussion of this phase of the program with other teachers. The fact that this knowledge is best obtained in a situation which closely approximates actual industrial conditions has been recognized but not extensively practiced in the school shops. The occupational information in the industrial-arts work is mentioned by T. T. Lindsey^{1/} who writes:

For practical purposes, occupational information to be given in the industrial arts may be thought of as consisting of two parts. First, that which is acquired through experience with tools, materials and processes of industry and a contact with whatever technical and related information is directly associated with it.

Manipulative experience in the industrial arts--No discussion of the importance of the industrial processes would be complete without some reference to the advisability and practicality of teaching by direct manipulative experience as we normally do in the greater part of the

^{1/} T. T. Lindsey, "Occupational Information in the Industrial Arts," Education (June 1932), Vol. 52, p. 619.

shop activities. An interesting experiment was conducted by Theresa C. Gunther^{1/} concerning this manipulative activity. Her problem was to find out if manipulative participation by the children in the study of industrial-arts in the elementary grades resulted in the learning and retention of a greater number of facts than by the conventional book method. She defined manipulative participation as:

...the handling of raw materials such as wood, clay, grains, in such a way as will enable the children to learn from first hand experiences with them their characteristics and properties, and to discover through construction and experimentation the fundamental processes involved in changing these raw materials into products in common use.

Her results proved conclusively that within the limits of the experiment the use of manipulative participation was superior. The gains in the number of facts learned were uniformly higher and the failures in retention were uniformly lower for the groups who had firsthand experience with the materials.

Discussion of terminology and definitions--Industry today is spending enormous sums of money in its research laboratories working with processes. The work entails the perfection of processes which are now in operation and the developing of new processes which will in turn manufacture new products and materials which will be made available to

^{1/} Theresa C. Gunther, "Manipulative Participation in the Study of Elementary Industrial Arts," Teachers College Record (March 1932), Vol. 33 p. 534.

the consumer. Educators have realized the value of this research but have not studied the processes themselves with the intention of developing lists of process activities for the use of the industrial-arts teacher.

At the present time opinions concerning the exact nature or the exact definition of an industrial process seem to raise controversial questions in the minds of many shop teachers. For example, broad terms such as refining or plumbing have been referred to as processes, yet they may be considered as trades or industries in themselves. Then again the term sanding is sometimes called a process when in reality this may be considered to be one operation or part of the abrading process. The words "process" and "industry" are very closely related. Alva C. Tagg^{1/} defines industry as:

...that process involved in the changing of raw materials to usable commodities through the use of skilled and intelligent labor.

Since the values of the industrial processes have been well established in the minds of educators, and since the principle that actual manipulative participation is educationally sound, a systematic search must be made to locate and list the most important processes in the major industrial areas.

^{1/} Alva C. Tagg, "Coordination of Industrial Education and Industry," Industrial Education Magazine (March 1935), Vol. 37, p. 89.

The Methods

Reactions to the inquiry method--Few technics of educational research are criticized or condemned with the vehemence which is usually directed at the questionnaire. Yet, with all the criticism it receives, few technics are as persistently employed. Quoting from two authors who strongly oppose this method, John Girdler^{1/} writes, "The questionnaire is ubiquitous, ineluctable, and a confounded nuisance," and Frank W. Hubbard^{2/} mentions, "The questionnaire has the dubious honor of receiving more criticism in print than almost any research technic." These gentlemen would no doubt question the sanity of the student who ventured forth with the inquiry method after reading their comments.

Factors effecting returns--There are five elements^{3/} which must be kept in mind when developing the inquiry form if even mediocre success is to be attained. These factors are:

1. The nature of the inquiry
2. The type of individual to whom sent
3. The prestige of the investigator
4. The length of the inquiry form

^{1/} John Girdler, "The Iniquitous Questionnaire," The School Executive (March 1936), p. 256.

^{2/} Frank W. Hubbard, "Questionnaires," Review of Educational Research (December 1939), Chapter IX, p. 502.

^{3/} Reid Seerley, "Respondents and Non-Respondents to Mail Questionnaires," Educational Research Bulletin (April 15, 1942), Vol. xxi, p. 87.

5. The ease with which it can be answered

All of these factors are important and will be kept in mind and discussed further in this chapter as the inquiry form is developed.

Mr. Seerley^{1/} also mentions the relatively poor percentage of returns for inquiry studies and that in the majority of cases this percentage falls between 25 and 50 per cent.

An interesting experiment was conducted by Clarence C. Moore^{2/} to find methods of increasing the returns from questionnaires. The three methods which he tried were transmittal by a duplicated copy, transmittal by a typewritten copy, and a follow-up reminder after a three-week period. His results indicated that the typewritten copy brought a 16 per cent higher return than the more common duplicated letter, and that the reminder brought an increase of 30.8 per cent of the total questionnaires mailed. In the first instance the typewritten letter had added the personal touch which the duplicated letter had lacked and the reminder had further obligated the receiver to comply.

The nature of the inquiry--Let us look for a moment at the nature of the inquiry by returning to the problem as stated in the beginning of this chapter. An attempt is
^{1/} Op. cit., p. 11.

^{2/} Clarence C. Moore, "Increasing the Returns from Questionnaires," Journal of Educational Research (October 1941), Vol. 35, pp. 138-141

being made to develop a list of the most important industrial processes which may be used as a basis for the selection of the manipulative activities in the school shop. The investigator's first thought concerning manipulative activities was along the line of hand or machine operations. After observation of the operations performed in industry it was realized that they were too numerous for a general list, were changing rapidly in their functions, and would not give a sound basis from which to select activities. It is assumed that operations are a part of the manipulative work in manufacturing but are too minute to lend themselves to unit organization as might the more broad area of processes. Since the unit organization requires a broad topical area from which to develop worth-while learning experiences, the operations would be of too limited a scope. It must be kept in mind, however, that the operations will undoubtedly be a part of the detailed organization of the units.

Development of a trial process list--Through extensive reading, lists of processes pertaining to the most important industries were compiled with the thought of submitting the lists to the different manufacturers for their evaluation and opinion. The frequency of the processes checked by the industrialist would be carefully recorded. This technic, however, would have proved of little value because few manufacturers and process men would have enough experience in fields outside their own industry to make any

accurate evaluation of any general process list which included processes not in their own industry.

Question Number 1--By allowing the industrialist to list the processes which were most important in his industry and then comparing the list received with lists from similar industries a good idea of the relative importance of the processes could be obtained. These processes could also be compared with the list which had been developed by the investigator from the reading and research about the major industries preliminary to this study.

The size of the industry as measured by the number of workers employed in which a certain process appeared would be significant of the relative importance of a process.

Through the above discussion, we now arrive at question Number 1, which requests the manufacturer to list the most important process in his industry. It was felt that space for the listing of six processes would provide ample coverage for any one company.

Question Number 2--Besides the actual listing of processes there are other things which must be learned about them to aid the educator in the evaluation of a process and to increase his understanding regarding their exact nature and peculiarities. Since the teaching of occupational information has been set as one of the goals of the shop teachers but has not been realized to its maximum, it will be interesting to note just how important a part the

processes may play in the occupational needs of a youth. Will experience in, or observation of, the main processes offer a sound basis for an occupational choice in a general area of work? The true or false answer to this question will signify to an extent the worth of the processes from an occupational viewpoint in our shop activity.

Questions 3, 4, and 5--In the research preliminary to this study, considerable was noticed regarding the many changes which are occurring in industry today. For example, S. Lewis Land^{1/} writes:

So rapid have been the changes in industry in recent years that perhaps about the only thing which we can count upon as constant and consistent is change.

One would immediately presume from this statement that if industry is in such a changing state, then the industrial processes may be in a similar condition and that perhaps they do not offer any adequate basis for our shop activities. On the other hand, in discussing this problem with other shop teachers, one notes the feeling that these processes may not be in such a state of fluctuation as the more colorful writer would portray. If, however, these processes are only being modified or undergoing slight changes, then they might offer the foundational basis which the shop

1/ S. Lewis Land, "Vocational-School Administrators and Technological Changes in Industry," Industrial Arts and Vocational Education (September 1932), p. 257.

manipulative activities require. Perhaps it is the products or applications of the processes which are really undergoing these changes.

The above paragraph leads us to the third, fourth, and fifth questions to be marked by the industrialist true or false.

3. Processes are fairly constant and undergo only minor changes.

4. Applications of processes change with the manufacture and development of new products.

5. The machines and operations used in a process are constantly undergoing changes.

It is important to remember that present reading which so strongly tells of the changes in industry would indicate that question Number 3 would be marked false as here stated.

Question Number 6--If the industrial processes are to be used as the basis for the manipulative work in industrial arts, we will need to know the exact breakdown or division of the process into its specific parts. We have considered in the past that the logical breakdown of a process was into operations and have subsequently selected a few of the many operations in an industry as the basis for general shop manipulative work. An opportunity is offered here to check this breakdown and see if it is justified or to locate any new division which may have developed. The sixth question, involving jobs, operations, or a third reaction,

which is left to the discretion of the manufacturer, will check this division.

Question Number 7--Three qualifications which are valuable to all industrial workers are skills, industrial information, and satisfactory work habits. Many trade and vocational schools have emphasized the skill development of the individual along narrow but highly technical lines. The youth has spent a comparatively large number of hours during his adolescent years in acquiring these skills. The present tendency among educators is to postpone this skill development until the youth has had sufficient opportunity to make a careful choice of vocational areas and then after this choice has been made to develop the special manual skills in later adolescence or young manhood. The fact that beginning workers, whether skilled or not, are required to do many unskilled and semiskilled jobs regardless of previous training has been brought to our attention by extensive research compiled by the United States Employment Service. An example can be cited of the highly trained machine lathe operator who upon graduation from the trade school begins his industrial experience as a helper or drill press operator. When skilled workers are in demand as in wartime this situation is seldom apparent.

Each plant has its own qualifications and requirements for the skilled worker, many of these requirements and skills the industrialists wish to teach and develop in

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their own way. This question concerning the qualifications which industry desires in the beginning worker is not irrelevant to the main problem concerning the industrial processes because industry's attitude toward the processes and the worker should have a definite bearing on the presentation of the processes in the school shop.

This discussion requires the development of question Number 7, which names the three areas of skills, information, and habits and requests the manufacturer to list these items in their one, two, three order of importance in the qualifications of the beginning workers.

Question Number 8--As will be noticed from earlier reading in this chapter, considerable debate and discussion is carried on among shop teachers regarding the exact nature of an industrial process. One feeling is that the word "process" is a broad term encompassing a trade; another, that its complexity or importance to the manufacture of a product establish it as a process. Question 8, which some readers will feel should be in position one, requests that a careful choice be made between three selected definitions of a process, or if none of these three is correct, space has been provided for the industrialist or process man to write a definition which is more applicable to the industrial-arts needs. Because of the difficulty of this question, it was placed last on the inquiry form with the feeling that if it were the first question and was very

difficult and thought-provoking the whole inquiry form might be thrown in the wastebasket resulting in few returns. Even if the inquiry form were returned with the last question unanswered, a knowledge concerning the manufacturer's interpretation of an industrial process could be gathered by a close examination of question Number 1.

The Selection of Industrial Areas

The classifying agencies--There are two main agencies in the United States Government which classify workers. The first is the Census Bureau in the Department of Commerce and the second is the Bureau of Employment Security in the Federal Security Administration. The Bureau of the Census is responsible for taking the census every ten years and in this census classifies workers by industries. An industry, as the term is used in the Bureau of the Census, is a unit of effort or organization, like a store, mine, or construction job. The workers in the industries are classified into 12 groups, the largest of which is the employed workers (except those on public emergency work). These employed workers are then classified into 13 different branches, which are listed as follows:

1. Agriculture
2. Mining
3. Construction
4. Manufacturing
5. Transportation, communication, public utilities
6. Wholesale and retail trade
7. Finance insurance and real estate
8. Business and repair services
9. Personal services

10. Amusement, recreation, and related services
11. Professional and related services
12. Government
13. Industry not reported

The manufacturing group--Because of the nature of this problem the manufacturing group is the area which will be able to supply the information concerning the industrial processes and so has been selected as the recipient of the inquiry forms. This manufacturing group is divided into eighteen divisions or classifications as listed below.

1. Food and kindred products
2. Textile-mill products
3. Apparel and other fabricated textile products
4. Logging
5. Sawmills and planing mills
6. Furniture, store fixtures, and miscellaneous wooden goods
7. Paper and allied products
8. Printing, publishing, and allied products
9. Chemicals and allied products
10. Petroleum and coal products
11. Leather and leather goods
12. Stone, clay, and glass products
13. Iron and steel and their products
14. Nonferrous metals and their products
15. Machinery
16. Automobiles and automobile equipment
17. Transportation and equipment, except automobiles
18. Other and not specified manufacturing industries

Adapting the census classification to the problem--For the purposes of industrial-arts activities it can be easily observed from this list of industrial areas that a few of these areas could be combined into more general groups. Items numbered two and three could be combined under the general heading of textiles. Items four, five, and six

might all be placed under the title of wood industries. A few of the last items, dealing with iron, steel, and machinery, might all be grouped under the heading of metal industries. Using the Bureau of the Census list as a guide and combining the industrial areas which are closely related, the following list of industries was developed. The inquiry forms totalling 250 in number were allotted to these groups.

1. Textile
2. Wood and lumber
3. Paper
4. Printing and publishing
5. Paint and varnish
6. Plastics
7. Glass and pottery
8. Leather and leather products
9. Rubber and rubber products
10. Metal industries
11. Miscellaneous industries

The distribution of the inquiry forms--Because this study was conducted in the New England area an arbitrary figure of 70 per cent was chosen as the percentage of inquiry forms to be allotted to the New England manufacturers.

The number of inquiry forms allotted to each individual industrial area, as listed above, was in a fair degree proportional to the importance of the industry according to number of workers employed and need to the consumer. The following list shows the number of inquiries which were sent to each of the manufacturing areas.

| The industry | Number of inquiries |
|---------------------------------|---------------------|
| 1. Metal industries | 60 |
| 2. Textile industries | 30 |
| 3. Wood and lumber | 30 |
| 4. Printing and publishing | 30 |
| 5. Paper manufacture | 20 |
| 6. Glass and pottery | 20 |
| 7. Paint and varnish | 15 |
| 8. Plastics | 15 |
| 9. Leather and leather products | 10 |
| 10. Rubber and rubber products | 10 |
| 11. Miscellaneous | 10 |
| Total | <hr/> 250 |

The metal industries which employ over twice as many workers as any other single industry was allotted a very large percentage of the inquiries. This group was followed by the three important industries of textiles, wood, and lumber.

The Covering Letter

Functions of the letter--For two reasons it was felt desirable to accompany the inquiry form with a personal letter. First, the inquiry form is very impersonal in its make-up and is not apt to arouse interest. Second, the expected increase in returns as a result of the letter would more than repay the extra effort and cost which it would require. This letter must, therefore, make four contributions to the study. It must (1) develop interest in the problem, (2) explain the problem more fully, (3) point out to the manufacturer the need for his co-operation, (4) and increase the number of returns.

Personal replies expected--It was also felt that the

covering letter might suggest to the manufacturer the possibility of writing further comments concerning the major problems of the inquiry form which could not be adequately given in the objective type of answer. Any subjective answers might give valuable information and place new light on the problems dealing with the industrial processes.

That after receiving there was considerable doubt in the industrialist's mind that the answers were specific and of assistance to the investigator. In this connection, it is evident that conditions concerning the industrial processes are not the same for each industry or perhaps each plant, and the problem of constructing an inquiry form which could meet all conditions in the major industries is almost an impossibility.

Because of the difficulties present in filling out the inquiry form, a few manufacturers disregarded the form entirely and, instead, wrote letters explaining their industry in relation to the questions asked on the form. These letters were of value and will be quoted from later in this chapter.

Manufacturers' Interest in the Inquiry Form—The second major relation to the inquiry form and the problem was the interest and diligence on the part of the manufacturers as co-operators. This does, without a doubt, indicate that industry is really concerned with the problem of linking

CHAPTER II

ANALYSIS OF THE RETURNS

General Reactions to the Inquiry Form

Difficulties experienced in answering--The first of the two main reactions of the manufacturers to the problem was that the inquiry form was too difficult to answer and that after answering there was considerable doubt in the industrialist's mind that the answers were specific and of assistance to the investigator. In this connection, it is evident that conditions concerning the industrial processes are not the same for each industry or perhaps each plant, and the problem of constructing an inquiry form which would meet all conditions in the major industries is almost an impossibility.

Because of the difficulties present in filling out the inquiry form, a few manufacturers disregarded the form entirely and, instead, wrote letters explaining their industry in relation to the questions asked on the form. These letters were of value and will be quoted from later in this chapter.

Manufacturers' interest in the problem--The second major reaction to the inquiry form and the problem was the interest and willingness on the part of the manufacturers to co-operate. This does, without a doubt, indicate that industry is really concerned with the problem of linking

education and industry and is more than willing to co-operate with the schools.

In addition to the letters, considerable printed material in the form of catalogs, pamphlets, and advertising material was received with the returned inquiry forms. The following quotations from the returns show the attitudes of the respondents in general to the problem and its method of approach:

Frankly, many of the questions seem a bit ambiguous. Conditions which exist in a definite industry and in a process in that industry often require more specific coverage.

We are not quite sure of the intent of all the questions and we are not quite sure of their application in each to the lumber business. However, if the information which we have furnished is in any way helpful, we are glad to do it.

If we can be of further service to you at any time, please do not hesitate to let me know.

Found it rather difficult to answer several of the questions because they are so worded that they could not be considered as true or false in reference to the printing industry.

We are not sure that any of the information we can furnish you will be of any help since you will note from our letter head that we are importers of foreign wood and manufacture all logs into lumber and veneers.

The severest critic of the problem made the statement below but did not explain the suggestion in any detail.

We feel that this questionnaire is much too academic. We appreciate your efforts but suggest a more practical approach to the problem of establishing a suitable industrial-arts program.

If the above criticisms are typical of the reactions

of the majority of the industries receiving inquiry forms, it is safe to assume that a return of 51 per cent is very favorable.

The Metal Industry Returns and Analysis

Main processes as suggested by the reading--In the preliminary research concerning the major processes of the metal industry, the following eight processes were considered to be of maximum importance: abrading, forging, turning, founding, welding, drawing, bending, and engraving. It will be of interest to compare this list with the main processes as listed by the industries on the inquiry forms.

Tabulating the metal industry returns--Of the 60 inquiry forms distributed in the metals industries, a total of 33 forms or letters were returned.

Table 1. The main processes in the metal industry

| Processes | Frequency of mention |
|---|-------------------------|
| Machining..... | 12 |
| Planing, milling, shaping, turning, boring, grinding | |
| Assembly and fabrication..... | 8 |
| Heat treating..... | 7 |
| Founding..... | 6 |
| Forging..... | 5 |
| Welding..... | 4 |

A great variety of processes were mentioned in these returns. The following list contains processes which were mentioned not more than twice; assaying, blanking, drawing,

enameling, finishing, fitting, forming, gear cutting, inspecting, pattern making, plating, refining, rolling, scraping, smelting, stamping, tapping, testing, and tool and die making.

It will be noticed from the returns of this industry and other industries as well, that the processes of assembling and fabricating are very important and have not been thoroughly recognized to any great extent by the shop teachers. An explanation for this may be in the fact that we have been too interested in hand skills and detailed operations and have overlooked the extent of these processes.

Questions 2, 3, 4, 5, and 6--The reader will notice by examining the sample inquiry form on page 106 of the appendix that questions 2, 3, 4, and 5 require the industrialist to check the statement as true or false. The following table shows the frequency of these checks.

Table 2. Questions 2, 3, 4, and 5

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 25 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 25 | 2 |
| Applications of processes change with the manufacture and development of new products..... | 15 | 11 |

Table 2. (Concluded)

| The question | Response | |
|--|----------|-------|
| | True | False |
| The machines and operations used in a process are constantly undergoing changes. | 15 | 14 |

It is important to note that in a few cases companies have veered from the general trend as two have done here by stating that the processes were rapidly changing. These companies are primarily interested in specialty products and since their products often change it is quite natural that the processes should undergo frequent changes.

The suggested divisions of jobs or operations were checked by the metal concerns as follows: Four manufacturers felt that the logical breakdown was into jobs while 16 felt that the operations in the metal industry were the better divisions.

Questions 7 and 8--The seventh question attempted to find from the industrialist where the most emphasis should be put on the qualifications of the beginning workers. The following table lists the qualifications as they appeared on the form and gives the position and frequency of their rating. It is significant to note at this time that the following qualification listing of the metal industry is very similar to the ratings as listed in the returns from the other industrial areas receiving the inquiry forms.

Table 3. Rating the beginner qualifications

| Qualification | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 9 | 15 | 1 |
| Industrial information.... | 2 | 1 | 22 |
| Work habits..... | 14 | 9 | 2 |

It may be observed from the above table that the corrected order of importance to the manufacturer of the qualifications of the beginning worker would be as follows:

1. Work habits
2. Manipulative skills
3. Industrial information

The following table states the suggested definitions of an industrial process and the frequency with which these definitions were checked by the manufacturer in the metal industry.

Table 4. Defining an industrial process

| The definition | Number of times checked |
|--|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 11 |
| b. A single or series of operations which radically change the material... | 11 |
| c. A broad term used to name a division or trade in an industry..... | 1 |
| d. The utilizing of raw or unfinished materials to make a product that is of value to the maker or to someone else.. | 1 |

There were two industrialists in the metal industry who felt that only a combination of a and b in Table 4 would satisfy the definition of a process.

A general observation can be stated that the returns from the metal industry corresponded very highly with the returns from the majority of industrial concerns.

The Textile Industry Returns and Analysis

Main processes as suggested by the reading--In the preliminary reading concerning the textile industry, the following four processes were considered to be important: spinning, weaving, finishing, and dyeing. These processes were considered to be important by the industrialists plus the addition of two other processes.

Tabulating the textile industry returns--The returns from the textile industry were very specific and the manufacturers seemed to experience no difficulty in filling out the form. Of the 30 inquiry forms distributed 12 were returned. The following table lists the main processes:

Table 5. The main processes in the textile industry

| Processes | Frequency of mention |
|----------------|-------------------------|
| Carding..... | 8 |
| Weaving..... | 8 |
| Finishing..... | 8 |
| Spinning..... | 7 |
| Dyeing..... | 5 |
| Bleaching..... | 4 |

The following processes were mentioned singly in the returns: calendering, embossing, filling, fulling, inspecting, knitting, sewing, top making, and yarn making.

Questions 2, 3, 4, 5, and 6--The following table shows the frequency of answers to the true and false replies which were requested.

Table 6. Questions 2, 3, 4, and 5

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 11 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 10 | 2 |
| Applications of processes change with the manufacture and development of new products..... | 8 | 2 |
| The machines and operations used in a process are constantly undergoing changes.... | 3 | 9 |

Operations were again considered to be the logical breakdown of the process, as was indicated by eight industrialists. Four manufacturers considered that jobs were the logical breakdown.

Questions 7 and 8--The following table describes the reactions of the manufacturers to the beginning worker qualifications. No industry had as clear-cut a conception of the importance of these qualifications as the textile industry.

Table 7. Rating the beginner qualifications

| Qualification | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 2 | 8 | 1 |
| Industrial information.... | 0 | 1 | 10 |
| Work habits..... | 9 | 2 | 0 |

The above table indicates to us that in the industrialist's mind these three factors have a distinct order of importance. Their proper order for the textile industry is:

1. Work habits
2. Manipulative skills
3. Industrial information

Only two of the three suggested definitions of an industrial process were checked in the textile industry. The following table shows the frequency in which they were checked.

Table 8. Defining an industrial process

| The definition | Number of times checked |
|---|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 8 |
| b. A single or series of operations which radically change the material... | 4 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

Table 7. Rating the beginner qualifications

| Qualification | Location of importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 8 | 8 | 1 |
| Industrial information..... | 0 | 1 | 10 |
| Work habits..... | 8 | 8 | 0 |

The above table indicates to us that in the industry trials' mind these three factors have a distinct order of importance. Their proper order for the textile industry is:

1. Work habits
2. Manipulative skills
3. Industrial information

Only two of the three suggested definitions of an industrial process were checked in the textile industry. The following table shows the frequency in which they were checked.

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|--|-------------------------|
| | |
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use... | 8 |
| b. A single or series of operations which radically change the material... | 4 |
| c. A broad term used to name a division or grade in an industry..... | 0 |

The Wood Industry Returns and Analysis

The main processes as suggested by the reading--A great variety of processes can be found in this industrial area. The most important which the reading suggested were sawing, planing, turning, fastening, and finishing. It will be noted from the process returns that there have been changes in the processes in this industrial area and that in some case entirely new industries using wood products have been developed.

Tabulating the wood and lumber processes--A total of 30 inquiry forms were sent to the wood and lumber products companies and of this number 16 were returned. Five of the forms were only partially filled out or were answered by a written letter.

Table 9. The main processes in the wood industries

| Processes | Frequency of mention |
|---------------------|-------------------------|
| Machining..... | 7 |
| Planing, sawing | |
| Logging..... | 4 |
| Veneer cutting..... | 4 |
| Bonding..... | 4 |
| Sanding..... | 4 |
| Seasoning..... | 3 |

The following processes were mentioned singly in the returns: inspecting, handling, matching, nailing, packing, sorting, trimming, and veneer flitching.

The wood and lumber returns combined activities under

the main process title of machining as was similarly done in the metal industry. The veneer and plywood industries have developed into important phases of the wood manufacture and will undoubtedly continue to develop in the coming years.

The wood industries found the inquiry form difficult to fill out or to adapt to their work. An explanation of this might be that some industrialists feel that the word process must refer to a chemical action and may not refer perhaps to a manipulative activity.

Questions 2, 3, 4, 5, and 6--The following table shows the comparative stability of the wood processes and indicates that they may be suitable for industrial-arts work.

Table 10. Questions 2, 3, 4, and 5.

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 11 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 11 | 1 |
| Applications of processes change with the manufacture and development of new products..... | 8 | 3 |
| The machines and operations used in a process are constantly undergoing changes... | 7 | 5 |

A much closer distinction between the suggested

the main process title of machining as was similarly done in the metal industry. The veneer and plywood industries have developed into important phases of the wood manufacture and will undoubtedly continue to develop in the coming

years.

The wood industries found the industry form difficult to fill out or to adapt to their work. An explanation of this might be that some industrialists feel that the word process must refer to a chemical action and may not refer perhaps to a manipulative activity.

Questions 2, 3, 4, 5, and 6--The following table shows

the comparative stability of the wood processes and industries that they may be suitable for industrial-arts work.

Table 10. Questions 2, 3, 4, and 5.

| Response | The question | |
|----------|---|----|
| | | |
| 0 | Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 11 |
| 1 | Processes are fairly constant and undergo only minor changes..... | 11 |
| 2 | Applications of processes change with the manufacture and development of new products..... | 8 |
| 3 | The machines and operations used in a process are constantly undergoing changes... | 7 |

A much closer distinction between the suggested

breakdown of a process into either jobs or operations was shown in the returns than was expected. Seven manufacturers felt that the operations were the logical breakdown and five felt that jobs were the logical breakdown. For years we have felt that operations were the only breakdown of a process but it was surprising to see that five manufacturers felt that jobs were the logical breakdown.

Questions 7 and 8--The following table will show that the qualifications of the beginning worker which were listed in the inquiry form are more closely related in the wood and lumber industries than in any other industries tested.

Table 11. Rating the beginner qualifications

| Qualification | Position of importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 3 | 4 | 2 |
| Industrial information..... | 2 | 2 | 4 |
| Work habits..... | 4 | 2 | 2 |

Although these qualifications were rated very closely in this industry the corrected order is the same as appears in the metal and textile industry.

1. Work habits
2. Manipulative skills
3. Industrial information

The following table shows present tendencies regarding the wood and lumber industries attitude toward the

breakdown of a process into either jobs or operations was shown in the returns than was expected. Seven manufacturers felt that the operations were the logical breakdown and five felt that jobs were the logical breakdown. For years we have felt that operations were the only breakdown of a process but it was surprising to see that five manufacturers felt that jobs were the logical breakdown.

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| Qualification | Position of importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 3 | 4 | 2 |
| Industrial information..... | 2 | 2 | 4 |
| Work habits..... | 4 | 2 | 2 |

Although these qualifications were rated very closely in this industry the corrected order is the same as appears in the metal and textile industry.

1. Work habits
2. Manipulative skills
3. Industrial information

The following table shows present tendencies regarding the wood and lumber industries attitude toward the

definition of an industrial process.

Table 12. Defining an industrial process

| The definition | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.... | 3 |
| b. A single or series of operations which radically change the material..... | 5 |
| c. A broad term used to name a division or trade in an industry..... | 1 |

One company which deals extensively with the raw materials and the preliminary process felt that the definition of a process indicated a trade or division of an industry. This reaction may be explained by the terms logging, mill work, and veneering, which are often referred to as separate industries and not considered as parts of the wood and lumber industry as the census classification indicates.

The Printing and Publishing Industry Returns

Main processes as suggested by the reading--The processes of composing, presswork, and binding were designated in the reading to be of prime importance. These three compare favorably with the returns of the manufacturers in these industries.

Tabulating the printing and publishing returns--In the printing and publishing industry 14 inquiry forms were

definition of an industrial process.

Table 12. Defining an industrial process

| Number of times checked | The definition |
|----------------------------|--|
| 3 | a. A chemical or physical action which brings about a distinct advancement in the material toward practical use..... |
| 3 | b. A single or series of operations which radically change the material..... |
| 1 | c. A broad term used to name a division or trade in an industry..... |

One company which deals extensively with the raw materials and the preliminary process felt that the definition of a process indicated a trade or division of an industry. This reaction may be explained by the terms logging, mill work, and veneering, which are often referred to as separate industries and not considered as parts of the wood and lumber industry as the census classification indicates.

The Printing and Publishing Industry Returns

Main processes as suggested by the reading--The processes of composition, presswork, and binding were designated in the reading to be of prime importance. These three compare favorably with the returns of the manufacturers in these industries.

Tabulating the printing and publishing returns--In the printing and publishing industry 14 industry forms were

returned out of 30 distributed. Four processes were frequently mentioned in these returns and eight were mentioned only once or twice.

Table 13. The printing and publishing processes

| Processes | Frequency of mention |
|-----------------------------------|-------------------------|
| Composition..... | 11 |
| Presswork..... | 11 |
| Binding..... | 9 |
| Electrotyping (plate making)..... | 8 |

The following processes were listed not more than twice in the returns: art work, analysis and design, cutting, drilling, engraving, estimating, finishing, folding, make-up and lock-up, paste-up, proofreading, and ruling.

Questions 2, 3, 4, 5, and 6--The following table shows the industrialists' opinion in regard to some of the detailed problems concerning the industrial processes.

Table 14. Questions 2, 3, 4, and 5.

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 13 | 1 |
| Processes are fairly constant and undergo only minor changes..... | 14 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 1 | 10 |
| The machines and operations used in a process are constantly undergoing changes.... | 5 | 8 |

The manufacturer who felt that observation of, or experience in, the processes would not offer a sound basis for an occupational choice thought so because he felt that both of these factors of observation and experience were essential and that neither one alone would be sufficient for the student to make a wise choice.

Five printing concerns felt that the first breakdown of a process was into jobs and seven felt that operations were the correct breakdown. The phrase "job printing" is often used in the printing industry but applies to the specific work being done rather than to the breakdown of the processes.

Questions 7 and 8--A slightly different trend can be observed from the following table in regard to the qualifications of the beginning worker in the printing industry in comparison with the returns of the metal, wood, and textile industries.

Table 15. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 8 | 4 | 1 |
| Industrial information.... | 1 | 1 | 11 |
| Work habits..... | 4 | 8 | 1 |

The above table indicates that the printing and publishing industries rank the beginning worker qualifications

in the following order:

1. Manipulative skills
2. Work habits
3. Industrial information

The printing industry was one of three industries which ranked the qualifications in the above order.

The returns analyzing the definitions of an industrial process are shown on the following table:

Table 16. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 4 |
| b. A single or series of operations which radically change the material... | 1 |
| c. A broad term used to name a division or trade in an industry..... | 6 |

The printing industry was the only industry to check item c more frequently than the other definitions. The fact that the printing concerns felt that the definition of a process was a broad term used to name a division or trade in an industry can be readily realized when one analyzes the names of printing and publishing concerns. For example, The Colonial Press, The Plimpton Press, and the National Library Binding Company are names of manufacturers and yet signify divisions or trades in the industry.

The Paper Industry Returns and Analysis

The main processes as suggested by the reading--The preliminary reading of the paper industry suggested the three processes of beating, screening, and sizing to be of major importance. The inquiry returns indicated that the process of screening is part of the manufacturing process carried out to a considerable extent on the Foundrinier machine. This machine actually performs the screening operation as it removes surplus water from the fibers while producing a shaking or vibrating motion which causes the fibers to interlock into a sheet of material. This material then becomes, after continued processing, the final sheet of paper.

Tabulating the paper industry returns--There were 30 inquiry forms distributed in this industry, of which 12 were returned. The following table lists the processes which appeared on the returns.

Table 17. The main processes in the paper industry

| Processes | Frequency of mention |
|----------------------------------|-------------------------|
| Finishing..... | 7 |
| Manufacturing..... | 6 |
| Foundrinier or cylinder | |
| Preparing the raw materials..... | 6 |
| Bleaching..... | 3 |
| Beating..... | 3 |
| Coating..... | 3 |
| Washing..... | 3 |

The following processes were mentioned singly in the returns: rag sorting and cutting, laminating, sheeting and reeling, packing, gumming, box making, embossing and die cutting, logging, pulping, tub sizing, and air drying.

The processes of beating and washing could be considered to be part of the process listed in Table 17 as preparing the raw materials, and the process of coating could be considered to be part of the finishing process although they were listed separately in the returns.

Questions 2, 3, 4, 5, and 6--Table 18 shows the reactions of the manufacturers in the paper industry to the true and false questions concerning the processes.

Table 18. Questions 2, 3, 4, and 5.

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 12 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 12 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 8 | 3 |
| The machines and operations used in a process are constantly undergoing changes.... | 6 | 5 |

In the paper industry there were nine concerns who felt that the first breakdown of a process was into operations while three companies felt that jobs were the

better breakdown or division.

Questions 7 and 8--The following table lists the beginning worker qualifications and the rating of each qualification as given by the manufacturers in the paper industry.

Table 19. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 3 | 6 | 3 |
| Industrial information.... | 0 | 1 | 9 |
| Work habits..... | 9 | 3 | 0 |

The corrected order of these qualifications to the beginning worker in the paper industry is:

1. Work habits
2. Manipulative skills
3. Industrial information

Table 20 states the three definitions of an industrial process and the frequency with which these definitions were checked by the manufacturers in the paper industry.

Table 20. Defining an industrial process

| Definitions | Number of times checked |
|---|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 5 |

Table 20. (concluded)

| Definitions | Number of times checked |
|---|----------------------------|
| b. A single or series of operations which radically change the material... | 7 |
| c. A broad term used to name a division or trade in an industry..... | 1 |

The Pottery Industry Returns and Analysis

Main processes as suggested by the reading--The nomenclature of the pottery processes derived from the reading was considerably different from the process list received on the inquiry forms from the manufacturers. The reading list contained the processes of shaping, firing, and decorating. The observation of the manufacturers' list will show, however, that the above three titles are important.

Tabulating the pottery industry returns--In this industrial area, 12 inquiry forms were distributed, of which four were answered. The following table lists the processes as mentioned by the manufacturers:

Table 21. The main processes in the pottery industry

| Processes | Frequency of mention |
|--------------------------|-------------------------|
| Manufacturing..... | 4 |
| Hand or machine | |
| Preparing the clays..... | 2 |
| Firing..... | 2 |
| Glazing..... | 2 |

The following processes were mentioned singly:

crating and shipping, art work, mining of materials, designing, testing, and sorting and warehousing.

It may be observed from the above table that the process of decorating which was taken from the reading may be too inclusive. The manufacturers' listing of glazing does not, however, take into consideration the activities of incising, coloring, applying, or any other medium which is designed to enhance the beauty of the product.

The process of shaping is probably too limited because the industrialist would include this in his process of manufacturing which includes all types of construction clay products.

Questions 2, 3, 4, 5, and 6--The pottery industry answered the true and false questions as shown in the following table.

Table 22. Questions 2, 3, 4, and 5.

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 4 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 4 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 3 | 1 |
| The machines and operations used in a process are constantly undergoing changes..... | 4 | 0 |

Only three of the returns answered the question regarding the breakdown of a process but all considered that the logical breakdown was into operations.

Questions 7 and 8--The following table shows the reactions of the pottery concerns to the beginning worker qualifications.

Table 23. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 3 | 1 | 0 |
| Industrial information.... | 1 | 0 | 3 |
| Work habits..... | 0 | 3 | 1 |

The above table indicates that the pottery industry like the printing industry was more interested in manipulative skills than any of the other characteristics. The corrected order of these qualifications would be:

1. Manipulative skills
2. Work habits
3. Industrial information

The emphasis may be placed here on the manipulative skills because of the fact that the pottery and clay products industry is made up of a large percentage of workers who are laborers or only semiskilled and a small group of workers who are highly skilled and carry on the technical work of importance in the industry.

The following table defines an industrial process in three separate definitions and shows the frequency with which these definitions were checked in the pottery industry.

Table 24. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 2 |
| b. A single or series of operations which radically change the material..... | 1 |
| c. A broad term used to name a trade or division in an industry..... | 1 |

The Glass Industry Returns and Analysis

The main processes as suggested by the reading--The preliminary reading in the area of glass manufacture suggested the following processes to be important: melting, smoothing and hardening, molding, finishing, spinning, and heat treating. These processes were quite definitely stated in the reading and it was expected that returns would to a large degree compare favorably with this list.

Tabulating the glass industry returns--Eight inquiry forms were distributed to the glass industry and seven of the forms were returned. The percentage of return was very high, but because of a poor selection of glass manufacturers a very wide range of processes resulted, which were of little use to the investigator. Because of this difficulty contact

was made with a specialist in a glass concern who understood the nature of the inquiry. The processes which he listed are reproduced in the following table. The frequency of mention in each case is one because these are the returns from a single industrialist.

Table 25. The main processes in the glass industry

| Processes | Frequency of mention |
|-------------------------------------|----------------------|
| Raw material selection and control. | 1 |
| Batch weighing and mixing..... | 1 |
| Melting..... | 1 |
| Forming by various methods..... | 1 |
| Annealing and tempering..... | 1 |
| After-working..... | 1 |

Among the other returns, the following processes were listed singly: grinding and polishing, drilling, forming, cutting, glass manufacturing, silvering, laminating, and tempering. It may be observed from this last group and from the processes mentioned in the preliminary reading that the specialist's process of after-working includes some of the activities which are mentioned in these lists. Although the frequency of the processes in Table 25 is only one, they can be considered to be valid as the industrialist had a thorough understanding of the problem before filling out the inquiry form.

Questions 2, 3, 4, 5, and 6--The true and false questions concerning certain peculiarities of the processes are listed in the following table:

Table 26. Questions 2, 3, 4, and 5

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 5 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 5 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 5 | 1 |
| The machines and operations used in a process are constantly undergoing changes.... | 5 | 1 |

Not all of the glass industry returns were answered completely, but five companies did consider that the first breakdown of a process was into operation. No Manufacturer checked that jobs might be the breakdown.

Questions 7 and 8--The glass industry rated the beginning worker qualifications in the order designated in the following table:

Table 27. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 1 | 4 | 1 |
| Industrial information.... | 0 | 1 | 5 |
| Work habits..... | 5 | 1 | 0 |

The corrected order for the qualifications in the glass industry parallels the returns from the majority of

the industries. This preferred order is:

1. Work habits
2. Manipulative skills
3. Industrial information

Much of the work done in the glass industry is of a chemical nature. It is quite logical to assume that this chemical characteristic would be mentioned in defining an industrial process in this industry.

Table 28. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 5 |
| b. A single or series of operations which radically change the material... | 2 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

The Paint and Varnish Industry Returns

Main processes as suggested by the reading--Preliminary reading in the paint and varnish industry areas indicated that the processes of thinning and mixing were of major importance. These processes consist of blending the ingredients which comprise paint and then thinning these ingredients to a usable consistency.

Tabulating the paint industry returns--The percentage of returns from the paint and varnish industries was lower

than from any other industrial area. Fifteen inquiry forms were distributed and of this number five were returned. The most important processes are listed in the following table:

Table 29. The main paint and varnish processes

| Processes | Frequency of mention |
|---------------------------|-------------------------|
| Thinning and tinting..... | 4 |
| Cooking (varnish)..... | 3 |
| Grinding..... | 3 |
| Mixing..... | 3 |
| Filling..... | 2 |

The following processes were listed singly in the returns: aging, filtering, labeling, and packing.

The mention of the process of cooking is important in the manufacture of varnish. The grinding process is important in the manufacture of lead paint.

Questions 2, 3, 4, 5, and 6--The following table shows the frequency of response to the true and false questions. Because the returns were so few, the results to these questions could not be considered valid for the entire paint and varnish industries but should be indicative of the reactions of a few companies to the problem. Only in this industrial area did there appear to be a difference of opinion in regard to the observing or experiencing of the processes as a sound basis for an occupational choice. No explanations or comments were jotted down on these returns to signify any reason for these opposing reactions. A much

greater distribution of inquiry forms might bring to light a definite industrial trend on this problem.

Table 30. Questions 2, 3, 4, and 5

| The question | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 2 | 2 |
| Processes are fairly constant and undergo only minor changes..... | 4 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 1 | 3 |
| The machines and operations used in a process are constantly undergoing changes.... | 0 | 5 |

Only three concerns answered the question regarding jobs or operations as the first breakdown of a process, but the three that did answer this question all checked the operations as the logical breakdown.

Questions 7 and 8--Table 31 shows the reactions of the manufacturers to the beginning worker qualifications.

Table 31. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 1 | 3 | 0 |
| Industrial information.... | 0 | 0 | 4 |
| Work habits..... | 3 | 1 | 0 |

greater distribution of industry forms might bring to light
a definite industrial trend on this problem.

Table 30. Questions 2, 3, 4, and 5

| The question | Response | |
|--|----------|------|
| | True | Fals |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 2 | 2 |
| Processes are fairly constant and undergo only minor changes..... | 4 | 0 |
| Applications of processes change with the manufacture and development of new products..... | 1 | 3 |
| The machines and operations used in a process are constantly undergoing changes.... | 0 | 3 |

Only three persons answered the question regarding
jobs or operations as the first breakdown of a process, but
the three that did answer this question all checked the
operation as the logical breakdown.
Questions 7 and 8--Table 31 shows the reactions of the
manufacturers to the beginning worker qualifications.

Table 31. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 1 | 3 | 0 |
| Industrial information..... | 0 | 0 | 4 |
| Work habits..... | 3 | 1 | 0 |

The corrected order for the beginner's qualifications in the paint and varnish industry would be:

1. Work habits
2. Manipulative skills
3. Industrial information

Considerable variance was noted in the defining of an industrial process in the paint and varnish industry. This variance of opinions is signified by the following table:

Table 32. Defining an industrial process

| Definitions | Number of times checked |
|---|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 4 |
| b. A single or series of operations which radically change the material... | 1 |
| c. A broad term used to name a division or trade in an industry..... | 1 |
| d. A combination of a, b, and c..... | 1 |

The Plastic Industry Returns and Analysis

Main processes as suggested by the reading--The processes which were mentioned in the reading included compression and injection, shaping, surfacing, polishing, and assembly.

It is important to note at this point that the activities in a newly developed industry may be undergoing more rapid changes than in such industries as wood and textiles,

which have been undergoing gradual development for perhaps thousands of years. Because of its youth as an industry, we may have the right to predict that rapid changes may be taking place in the field of plastics. This may have an effect on its presentation in an industrial-arts course.

Tabulating the plastics industry returns--Of the 15 inquiry forms sent to the manufacturers five were returned completely answered. The following table lists the processes which were mentioned on these returns.

Table 33. The main processes in the plastic industry

| Processes | Frequency of mention |
|---------------------------------------|-------------------------|
| Molding..... | 5 |
| Chemical or compound manufacture..... | 2 |
| Fabricating..... | 2 |
| Finishing..... | 2 |
| Laminating..... | 1 |

The following so-called processes were listed singly in the returns: die making, extruding, choice of material, compression, tool design, and transfer.

Attention should be called to the two processes of compression and injection which were noticed in the reading. The industrialist has pointed out that these are methods used in the over-all process of molding. They are types of molding and should not be considered as processes in themselves.

The finishing process as listed by the manufacturer

which have been undergoing gradual development for perhaps thousands of years. Because of its youth as an industry, we may have the right to predict that rapid changes may be taking place in the field of plastics. This may have an effect on its presentation in an industrial-arts course.

Tabulating the plastic industry returns--Of the 15 inquiry forms sent to the manufacturers five were returned completely answered. The following table lists the processes which were mentioned on these returns.

Table 33. The main processes in the plastic industry

| Processes | Frequency of mention |
|---------------------------------------|----------------------|
| Molding..... | 5 |
| Chemical or compound manufacture..... | 2 |
| Fabricating..... | 2 |
| Finishing..... | 2 |
| Laminating..... | 1 |

The following so-called processes were listed singly in the returns: die making, extruding, choice of material, compression, tool design, and transfer.

Attention should be called to the two processes of compression and injection which were noticed in the reading. The industrialist has pointed out that these are methods used in the over-all process of molding. They are types of molding and should not be considered as processes in themselves.

The finishing process as listed by the manufacturer

should normally include the activities of shaping, surfacing, and polishing which were designated as processes in the reading.

Questions 2, 3, 4, 5, and 6--Our previous mention of the changing qualities of a new industry can be noticed in the table listing the answers to the true and false items.

Table 34. Questions 2, 3, 4, and 5

| The questions | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 5 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 2 | 3 |
| Applications of processes change with the manufacture and development of new products..... | 4 | 1 |
| The machines and operations used in a process are constantly undergoing changes.... | 4 | 1 |

Operations were considered to be the first breakdown of an industrial process by five manufacturers and jobs were felt to be the better breakdown by one plastic concern.

Questions 7 and 8--In the plastic industry there are two groups of workers; one group, comprising a large percentage of the total employed, are unskilled or semi-skilled workers, the second group numbering only a few of the industry's total are highly skilled and technical.

The following table shows the ranking of the beginning

worker's qualification needs:

Table 35. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 2 | 2 | 0 |
| Industrial information.... | 2 | 0 | 3 |
| Work habits..... | 1 | 2 | 1 |

The corrected order of these qualifications, at least as shown by these few returns, would be:

1. Manipulative skills
2. Work habits
3. Industrial information

Although there is little numerical difference between the frequency in which these qualifications were checked, it is of interest to note that this is the third industry which rated manipulative skills in the first position of importance.

Table 36. Defining an industrial process

| Definitions | Number of times checked |
|---|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 3 |
| b. A single or series of operations which radically changes the material.. | 2 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

worker's qualification needs:

Table 35. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 2 | 2 | 0 |
| Industrial information.... | 2 | 0 | 3 |
| Work habits..... | 1 | 2 | 1 |

The corrected order of these qualifications, at least

as shown by these few returns, would be:

1. Manipulative skills

2. Work habits

3. Industrial information

Although there is little numerical difference between

the frequency in which these qualifications were checked,

it is of interest to note that this is the third industry

which rated manipulative skills in the first position of

importance.

Table 36. Defining an industrial process

| Definitions | Number of times checked |
|---|-------------------------|
| | |
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 3 |
| b. A single or series of operations which radically changes the material.. | 2 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

The Leather Industry Returns and Analysis

Tabulating the leather industry returns--Eight of the ten returns distributed in this industry were returned. The preliminary reading list of processes was so similar to the returns on the inquiry forms that there is no need for comparison. The following table lists the major processes:

Table 37. The main processes in the leather industry

| Processes | Frequency of mention |
|----------------|-------------------------|
| Tanning..... | 6 |
| Finishing..... | 6 |
| Coloring..... | 4 |

The following processes were mentioned not more than twice in the returns: bating, beaming, drying, oiling, pickling, soaking, and unhairing.

Questions 2, 3, 4, 5, and 6--The following answers to the true-false questions indicate similarities between the leather industry and the other areas examined.

Table 38. Questions 2, 3, 4, and 5

| The questions | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 6 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 5 | 2 |

Table 38. (concluded)

| The questions | Response | |
|--|----------|-------|
| | True | False |
| Applications of processes change with the manufacture and development of new products..... | 6 | 1 |
| Machines and operations used in a process are constantly undergoing changes.... | 4 | 3 |

Five leather manufacturers felt that the first breakdown of an industrial process was into operations and three industrialists checked that jobs were the first division.

Questions 7 and 8--Table 39 ranks the three beginning worker qualifications of skills, habits, and information, in their prescribed order for this industry.

Table 39. Rating the beginner qualifications

| Qualifications | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 2 | 4 | 0 |
| Industrial information.... | 1 | 1 | 4 |
| Work habits..... | 3 | 1 | 2 |

The corrected order of these three qualifications to the leather industry would be:

1. Work habits
2. Manipulative skills
3. Industrial information

The leather industry's analysis of the definition of an industrial process is shown by the following table:

Table 40. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 4 |
| b. A single or series of operations which radically change the material... | 4 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

The Rubber Industry Returns and Analysis

Tabulating the rubber industry returns--One outstanding process which was mentioned in the reading concerning the rubber industry was the vulcanizing process. The manufacturers who answered the inquiry forms mentioned this process also but did not mention it with the frequency of other equally important processes.

Of the ten inquiry forms distributed, eight were returned partially filled out.

Table 41. The main processes in the rubber industry

| Processes | Frequency of mention |
|-------------------------------------|-------------------------|
| Compounding (mixing and milling)... | 7 |
| Finishing..... | 5 |
| Vulcanizing..... | 3 |
| Molding and shaping..... | 3 |

The following processes were listed singly in the returns: assembling, calendering, coating, embossing, impregnating, and visualizing.

Questions 2, 3, 4, 5, and 6--The answers to the true-false questions are illustrated by the following table:

Table 42. Questions 2, 3, 4, and 5

| The questions | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 6 | 1 |
| Processes are fairly constant and undergo only minor changes..... | 4 | 3 |
| Applications of processes change with the manufacture and development of new products..... | 8 | 0 |
| The machines and operations used in a process are constantly undergoing changes.... | 6 | 2 |

Operations were considered to be the normal breakdown of a process by seven of the industrialists and only one manufacturer considered that this breakdown was into jobs.

Questions 7 and 8--Table 43 gives the results of the rubber industry's ranking of the beginning worker traits.

Table 43. Rating the beginner qualifications

| Qualification | Position of importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 1 | 5 | 1 |
| Industrial information..... | 0 | 2 | 5 |
| Work habits..... | 7 | 0 | 1 |

The corrected order of these qualifications to the rubber manufacturer is:

1. Work habits
2. Manipulative skills
3. Industrial information

The following table gives the reactions of the industrialist to the various definitions of a process.

Table 44. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 5 |
| b. A single or series of operations which radically changes the material.. | 5 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

Analysis of the Miscellaneous Returns

Tabulating the industrial processes--Six inquiry forms were sent to different industrial areas not covered in the ten major classifications. Three inquiry forms were returned representing the abrasive, cement, and photographic industries. The major processes in these groups are listed below:

Abrasive or grinding wheel industry

Moulding (clays and abrasives)

Kiln drying

Machining

Testing, packing, shipping

Cement industry

Preparing raw materials
 Blending and control
 Burning
 Grinding
 Packing and loading

Photographic

Distillation
 Crystallization
 Machining

Questions 2, 3, 4, 5, and 6--Table 45 shows the reactions of these industrialists to the true-false questions.

Table 45. Questions 2, 3, 4, and 5

| The questions | Response | |
|---|----------|---------------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 3 | 0 |
| Processes are fairly constant and undergo only minor changes..... | 2 | (Photo) 1 |
| Applications of processes change with the manufacture and development of new products..... | 2 | (Cement) 1 |
| The machines and operations used in a process are undergoing constant changes..... | 1 | (Photo) 2 |

These three industries felt that the first breakdown of a process was into operations and not into the job area.

Questions 7 and 8--The qualifications of the beginning worker and their importance to the industrialist are designated in the following table:

Table 46. Rating the beginner qualifications

| Qualification | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 0 | 2 | 1 |
| Industrial information.... | 0 | 1 | 2 |
| Work habits..... | 3 | 0 | 0 |

The corrected order of importance to the industrialist of these three qualifications is:

1. Work habits
2. Manipulative skills
3. Industrial information

Table 47. Defining an industrial process

| Definitions | Number of times checked |
|---|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 2 |
| b. A single or series of operations which radically change the material... | 1 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

Because these returns are from three manufacturing concerns in three different industrial areas they are not to be interpreted as general industrial tendencies but as trends in these individual companies.

The Summary Analysis

Tabulating the industrial processes--The following

Table 46. Rating the beginner qualifications

| Qualification | Position of Importance | | |
|-----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 0 | 2 | 1 |
| Industrial information..... | 0 | 1 | 2 |
| Work habits..... | 2 | 0 | 0 |

The corrected order of importance to the industrialist

of these three qualifications is:

1. Work habits
2. Manipulative skills
3. Industrial information

Table 47. Defining an industrial process

| Definitions | Number of times checked |
|--|-------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use... | 2 |
| b. A single or series of operations which radically change the material... | 1 |
| c. A broad term used to name a division or trade in an industry..... | 0 |

Because these returns are from three manufacturing concerns in three different industrial areas they are not to be interpreted as general industrial tendencies but as trends in these individual companies.

The Summary Analysis

Tabulating the industrial processes--The following

processes are arranged according to their frequency of mention in the various industries in which they occurred.

Metal industry

Machining
Planing, milling
Shaping, turning
Boring, grinding
Assembly--fabrication
Heat treating
Founding
Forging
Welding

Paper industry

Finishing
Manufacturing
Foundrinier
Cylinder
Preparing the raw materials
Bleaching
Washing
Coating

Textile industry

Carding
Weaving
Finishing
Spinning
Dyeing
Bleaching

Pottery industry

Manufacturing
Hand
Machine
Preparing the clays
Firing
Glazing

Wood and Lumber industry

Machining
Sawing
Planing
Logging
Veneer cutting
Bonding
Sanding
Seasoning

Glass industry

Raw material selection and control
Batch weighing and mixing
Melting
Forming
Annealing
After-working

Printing & Publishing

Composition
Presswork
Binding
Electrotyping
Plate making

Paint and Varnish industry

Thinning and tinting
Cooking (varnish)
Grinding
Mixing
Filling

Plastic industry

Molding
Fabricating
Finishing
Laminating
Chemical or compound manufacture

Rubber industry

Finishing
Compounding
mixing and milling
Molding and shaping
Vulcanizing
Calendering

processes are arranged according to their frequency of mention in the various industries in which they occurred.

| | |
|---|--|
| <p>Paper Industry</p> <p>Finishing Manufacturing Foundry Cylinder Preparing the raw materials Bleaching Washing Coating</p> | <p>Metal Industry</p> <p>Machining Planing, milling Shaping, turning Boring, grinding Assembly-fabrication Heat treating Forming Forging Welding</p> |
| <p>Pottery Industry</p> <p>Manufacturing Hand Machine Preparing the clays Firing Glazing</p> | <p>Textile Industry</p> <p>Carding Weaving Finishing Spinning Dyeing Bleaching</p> |
| <p>Glass Industry</p> <p>Raw material selection and control Batch weighing and mixing Melting Forming Annealing After-working</p> | <p>Wood and Lumber Industry</p> <p>Machining Sawing Planing Joining Veneer cutting Bonding Sanding Seasoning</p> |
| <p>Paint and Varnish Industry</p> <p>Thinning and filtering Cooking (varnish) Grinding Mixing Milling</p> | <p>Printing & Publishing</p> <p>Composition Presswork Binding Electrotyping Plate making</p> |
| <p>Rubber Industry</p> <p>Finishing Compounding Mixing and milling Molding and shaping Vulcanizing Calendering</p> | <p>Plastic Industry</p> <p>Molding Fabricating Finishing Laminating Chemical or compound Manufacture</p> |

Leather industry

Tanning
Finishing
Coloring

Questions 2, 3, 4, 5, and 6--The following table shows the summary figures of the reactions of the manufacturers to the true-false questions:

Table 48. Summary of questions 2, 3, 4, and 5.

| The questions | Response | |
|---|----------|-------|
| | True | False |
| Observation of, or experience in, the above main processes offers sound basis for an occupational choice in certain job fields..... | 103 | 4 |
| Processes are fairly constant and undergo only minor changes..... | 98 | 14 |
| Applications of processes change with the manufacture and development of new products..... | 69 | 36 |
| The machines and operations used in a process are constantly undergoing changes.... | 60 | 54 |

The fact that 103 returns signified that observation of, or experience in, the above main processes does offer a sound basis for an occupational choice, indicates the value of the processes as an aid to the occupational needs of the students. This almost unanimous attitude of industry also indicates the importance of the processes in any industrial organization or activity.

The reason that some manufacturers, four in all, took the opposite view to this question has been explained in

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The reason that some manufacturers, four in all, took the opposite view to this question has been explained in

part by the fact that some companies are specialty manufacturers whose products and processes are constantly changing. Perhaps others checked this question as false for the same reason as the manufacturer who felt that observation or experience alone was not enough but that it required both of these items for a satisfactory choice.

The fact that processes are fairly constant and undergo only minor changes (98 true, 14 false) is sufficient proof that they offer a sound basis from which to select the manipulative activities of the school shops. This result, 98 to 14, would indicate that it is not the processes which are undergoing the changes that are taking place in industry, as is mentioned earlier in this study^{1/}.

In searching for this element of change which is present in industry and its relationship to the industrial processes, the question was asked to discover if it is the applications of the processes and the products which are continually undergoing transformation. The group of 69 industrialists who felt this was true is fair proof of this fact, but the fact that 36 manufacturers felt that even the applications of the processes were not changing would tend to substantiate the claim in the preceding paragraph that the processes do offer a sound basis for the shop program.

Great difference of opinion concerning the changing qualities of the machines and operations is evident in the

^{1/} Op. cit. p. 15

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fact that 60 concerns felt that the machines and operations were changing while 54 companies felt that they were not undergoing any great changes. We can gather from this that in some industries the machines are constantly undergoing changes, especially in fairly new industries, but that in many industries the equipment and detailed operations remain about constant. Many notes were jotted down on the returned forms, indicating that the machines were undergoing slight improvements but not constant or radical changes.

The return from a well-known printing supply house stated:^{1/}

The equipment in the printing industry is not under constant change but is subject from time to time to improvements.

Comments such as, "Do not change radically or undergo only gradual change," appeared on 12 inquiry forms. A question causing such comment demonstrates that it was poorly constructed and should have been worded to give a more definite and easily answered response.

Concerning the problem of breakdown of a process, 77 industrialists felt that operations were the first breakdown and 25 felt that jobs were the better division. A few manufacturers interpreted the word "breakdown" to mean malfunction or collapse and in such cases gave an answer that is not applicable to this study.

Questions 7 and 8--A most interesting revelation in

^{1/} John A. Backus, American Type Founders Sales Corp., 200 Elmora Ave., Elizabeth, New Jersey.

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Questions V and B--A most interesting revelation in

John A. Bowers, American Type Foundry Sales Corp., 200
 Elmora Ave., Elizabeth, New Jersey.

this study comes from the reactions of the manufacturers to the beginning worker qualifications of manipulative skills, industrial information, and work habits. The following table gives the total figures of the positioning of these three traits:

Table 49. Rating the beginner qualifications

| Qualification | Position of importance | | |
|----------------------------|------------------------|--------|-------|
| | First | Second | Third |
| Manipulative skills..... | 35 | 58 | 11 |
| Industrial information.... | 9 | 11 | 82 |
| Work habits..... | 62 | 32 | 10 |

The corrected order of importance of these three qualifications to the industries participating in this study is:

First, Work habits

Second, Manipulative skills

Third, Industrial information

From the figures in the above table it is readily observed that work habits has almost a two to one ratio over skills for the most important characteristic or qualification necessary for the beginner in industry. This fact must be taken into consideration in all our shop activities and especially in the experiencing of these industrial processes in the school industrial-arts laboratory.

Skills are important to the manufacturer and it must be kept in mind that the three industries of printing,

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esses in the school industrial-arts laboratory.

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be kept in mind that the three industries of printing,

pottery, and plastics placed skills in their first category.

Another consideration to note is that in all industries the qualification of industrial information was placed in a very decided third position.

An interesting comment on these three qualifications was received from a glass manufacturer who stated:^{1/}

Skills are definite assets, but most manufacturers find it necessary to provide their own training under their own particular conditions and are consequently interested in knowing whether the beginner has the proper attitudes.

The above statement is indicative of the thinking of many industrialists when confronted with these three important phases of training.

Table 50. Defining an industrial process

| Definitions | Number of times checked |
|---|----------------------------|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use.. | 55 |
| b. A single or series of operations which radically change the material... | 44 |
| c. A broad term used to name a division or trade in an industry..... | 11 |
| d. A combination of (a) and (b) or a combination of all three (a), (b), (c)... | 4 |

The results of this table show that no single definition can apply directly to all the processes in all industries. The suggestion that a complete definition would

^{1/} H. M. LeClair, Dupaul-Central Optical Company, Inc., Southbridge, Mass.

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Table 50. Defining an industrial process

| Number of times checked | Definitions |
|----------------------------|--|
| 52 | a. A chemical or physical action which brings about a distinct advancement in the material toward practical use... |
| 44 | b. A single or series of operations which radically change the material... |
| 11 | c. A broad term used to name a division or trade in an industry..... |
| 4 | d. A combination of (a) and (b) or a com- bination of all three (a), (b), (c)... |

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W. R. M. Redfern, Dupont-General Optical Company, Inc.,
Southbridge, Mass.

embody the major elements of all three definitions is perhaps the only complete answer to the definition of an industrial process.

An important comment on the problem by an industrialist--Mr. E. R. Andrews of the Hyde Windlass Company at Bath, Maine, did not rank the three qualifications of the beginning worker, but instead wrote the following comments which characterize a sound philosophy of education and especially of industrial-arts education.

Give them [the pupils] a chance for orientation. It is not so much what you people teach or how you teach it, as it is the information you offer on various trades and types of work which are done in your community or elsewhere which will lead the child into fields in which he is definitely interested and can enjoy a happy and prosperous life in his chosen field. Methods teaching in school will in all probability have to be corrected in industry due to the different ways of doing things between one plant and another. It would seem that exploratory work on the part of the schools, giving if you will basic practice in as many fields as you can offer and lectures, movies, plant visits, industrial working cooperation, will give the pupil the knowledge he or she needs to choose for himself his own work field.

Programs should be left broad and not specialized at the age level you are dealing with. Leave the specialization to the industries and trade schools, after the pupil has had the best opportunity to make his or her selection.

Few industrialists have had the interest and insight to set down such a clearly defined and sound philosophy as Mr. Andrews has written. If all teachers of industrial-arts shops and pre-vocational activities had a similar understanding and were attempting to attain the goals here set forth, much progress would be made toward meeting the

needs of the pupils in this industrial society.

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CHAPTER III

APPLICATION OF THE PROCESSES

Values Derived From Process Experience

Summarizing discussion of our objectives--In Chapter I, page 4, there were listed some specific objectives of our industrial-arts curriculum. These objectives were designed to meet specific needs, purposes, and interests of the pupils in our secondary-school program. A closer examination of the items as listed on page 4 reveals that they might be classified into groups of common and personal needs. By common needs we mean those knowledges, concepts, attitudes, and skills which are needed by all pupils. While achieving these common industrial needs in the school shop, the student will begin to develop some personal needs, purposes, and interests of his own which the school shop program must attempt to satisfy. Some of these personal needs may deal with an occupation which he desires, an application of some tool skill in his home, or perhaps some personal item of furniture which he wishes to build.

These common needs may be divided into three main categories: (1) industrial and occupational needs, (2) consumer needs or standards of evaluation, selection, utilization, and consumption of industrial products, and (3) exploratory and investigative needs, as hobbies, crafts, and handy-man abilities.

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It is the contention of most teachers that we must

choose to satisfy these stated needs of the student in one of two ways; either by an academic, rote-memory, blackboard-teaching approach, or by a vitalized activity program based on the experiencing of the important industrial processes in the school's industrial laboratory. The reader may judge for himself which of these two methods offers the better learning situation and will be more beneficial to the student.

In the following paragraphs, we will discuss the contributions which the processes may make to these general areas of pupil needs.

Opportunity for broad industrial experience--When we speak of a broad industrial experience, the thought often comes to the mind of the reader that so much material is to be presented that no intrinsic value will result. Success in this problem is dependent upon such carefully planned teaching activities that the material will not be shallow and sketchy but will offer functional material from a variety of sources. An example of using the processes in an industrial-arts unit will be presented at the close of this chapter and will attempt to demonstrate how a broad yet functional industrial experience may be achieved in the school shop.

Chapter I contains quotations from the writings of leading educators stating that our industrial-arts experience should be broad in scope. Especially is this true

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in the junior-high-school grades where the industrial-arts work is now formally organized.

The selection of processes from different industrial areas as a basis for the manipulative activities will enable the student to obtain a broad understanding and a variety of experiences closely approximating industry. Any attempt at specialization in these years would so narrow the youth's thinking that he would be hindered in later years from making a wise occupational choice. As exploratory, our courses should give basic industrial experience to all students and should offer the opportunity to the interested student to conduct further study to attain any individual or personal goals which may have arisen from his shop work.

Basis for an occupational choice--Many of the industrial-arts students will undoubtedly go into the trades or factories to earn their livelihood. By offering a broad industrial experience in the school shop, there is the possibility that a field of work will be presented which will interest the youth further. The school program should attempt in this case to provide him with the pre-vocational skill necessary for later success in his chosen area.

It is important that the student be given a general understanding of his industrial society and a picture of many of its component parts. Along with this knowledge about industry which is an absolute necessity, the student must know his own abilities, interests, and limitations.

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It is important that the student be given a general understanding of his industrial society and a picture of many of its component parts. Along with this knowledge about industry which is an absolute necessity, the student must know his own abilities, interests, and limitations.

The school will not have done its part in helping the boy to a successful and happy life if it has neglected any of these real needs.

Since the returns from the inquiry form have so conclusively shown that the processes do offer a sound basis for an occupational choice, it is evident that we must allow the pupil to experience these processes in the school. He cannot achieve as real or vital learning results from the academic approach to his occupational problems as he will from the actual use of realia in these learning situations. The processes offer the realia which will vitalize his experience and make this learning situation of significant importance to himself.

Contribution to work and worker appreciations--The returns from the inquiry form also indicated that industry is interested in the development of satisfactory work habits in the beginning worker. Our schools may contribute much to this work habit development by our teaching and administering of the shop.

Through a unit in production work, factory methods may be studied and experienced.

The pupil personnel organization which handles many routine jobs such as distribution of supplies, shop maintenance, tool room management, and clean-up duties is an excellent tool in the hands of the instructor to develop an appreciative understanding and spirit of co-operation among

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Contribution to work and worker suggestions--The

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The pupil personnel organization which handles many routine jobs such as distribution of supplies, shop maintenance, tool room management, and clean-up duties is an excellent tool in the hands of the instructor to develop an appreciative understanding and spirit of co-operation among

fellow workers.

Related occupational information concerning the work, worker's duties, qualifications, methods of entry, advancement, and conditions of employment may all be developed while the pupil is working on an industrial process.

Through the above techniques satisfactory work habits will be developed and will be carried by him into the industrial experience which may be his livelihood.

Contribution to consumer needs--Through the experience with the processes in the school shop the student will become acquainted with the development of products from the processes. His work with the processes offers the student the opportunity to look behind the product which he sees in the store window, and picture the men, materials, and processes which contributed to the finished goods. The shop manipulative work will become the steppingstone or incentive for further investigation under the guidance of the instructor to test, compare, select, and use these products. Through the evaluation of his own handiwork he will become better able to judge the craftsmanship of others.

The first step in any consumer knowledge is to know what has taken part in the construction of a product. Quality in products is dependent upon workmanship and material. By working with the material in a manner similar to industry, insights will be developed which will be the foundation for the selection of many consumer products which the student will use throughout his life.

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Contribution to consumer needs--Through the experience

With the processes in the school shop the student will become acquainted with the development of products from the processes. His work with the processes offers the student the opportunity to look behind the product which he sees in the store window, and picture the men, materials, and processes which contributed to the finished goods. The shop manipulative work will become the steppingstone or incentive for further investigation under the guidance of the instructor to test, compare, select, and use these products. Through the evaluation of his own handiwork he will become better able to judge the craftsmanship of others.

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Exploratory and investigative values--Many hobby, craft, and leisure-time activities may be suggested by the many process activities. Such activities as block cutting, etching, glass blowing, leather finishing, plastic finishing, pottery glazing, and paper making are samples of hobbies which are developed from the industrial processes. The decorating processes offer interesting and educational experiences to the student.

The tendency exists when working with the industrial processes in the shop to stress only the industrial and occupational application of the activity. The cultural and esthetic values must be developed by the teacher and the process used by the student in a variety of ways. It is not necessary for the shop instructor to teach these hobby skills in detail or be proficient in them himself, but it is essential that he provide the material, equipment, and reference reading necessary for the student to study and explore as much as he wishes.

Facilities should not only be available for work in the hobby processes in the school shop but craft clubs for both youth and adults should explore these areas in the after school hours. Information and advice should be suggested to the student who is interested in setting up some hobby process activity in his own home workshop. The contributions which the processes can make in these areas is practically unlimited.

Manual skill and dexterity--A common objective of industrial-arts has often been stated as elementary manual skill but little has been accomplished to accurately define the terms. We know that it requires manual skill to change a tire, repair a faucet, replace a broken pane of glass, paint the cellar stairs, or repair a weakened chair. From these examples of manual activities which we are occasionally called upon to perform, we can see that it first requires a knowledge of and ability to use many hand tools. These hand tools are not restricted to any one area such as woodworking or metalwork but are used in many areas of work.

Some common tools which all home owners should be familiar with are the hand drill, saw, plane, hacksaw, chisel, screwdriver, wrenches, knives, crowbar, paint brush, nail set, soldering iron, pliers, auger bits and brace, putty knife, bench vise, clamps, and tin snips. These same tools are used extensively in the school shop in the working out of an industrial process. During this process experience enough manual skill can be developed in the student to use these tools with safety to himself and others and with a fair degree of proficiency. This is an attempt at least to describe the elementary manual skill necessary for the jobs which were mentioned earlier in this section. If the student shows interest and ability in industrial work he should be allowed and encouraged to develop this skill to the proficiency level necessary for the beginning worker.

Manual skill development is necessary and of value in the school industrial-arts but it has been emphasized in many school programs to such an extent that valuable industrial information, consumer knowledge, and exploratory material has been disregarded. The unhealthy situation of school shops becoming the dumping ground for the problem cases has been a result of our narrow interest in only skill development. This condition is rapidly disappearing and real industrial-arts teaching will soon make local school committees, administrators, and the public aware of the values inherent in a broad industrial laboratory process experience.

Teaching the Industrial Processes

Benefits of modified process experience--No one would dispute for a moment that the best way to have the student experience the industrial processes is to create a situation which as nearly as possible resembles the actual situation or condition in industry. It is quite evident that for many reasons such as cost, equipment, space, and lack of skilled workers this actual situation may seldom be accomplished in our schools. An alternative method or methods must be presented to the student to supplant this difficulty. The best alternative thus far arrived at in the shops is to present the processes in the form of a model of the actual activity or of the hand rather than the machine process. Through these modified activities, skills,

knowledges, habits, attitudes, and insights may be obtained which closely parallel the true industrial experience.

An example of this modified activity is carried on in the Weeks Junior High School in Newton, Massachusetts, in a paper-making unit. A model pulp beater has been constructed by the instructor which is about the same size as a school woodworking bench. This beater performs the beating of the materials into pulp in the paper making process. The manner in which the beating is performed and the quality of the result correspond very highly with the results obtained from the large beaters in the industrial paper mills. The only concept which the student lacks after using the model is the concept of size. This omission is of no great consequence, but with the use of visual aids or industrial visits to aid in the teaching, all knowledges and concepts of the industry which are important to the pupil at this stage of his life can be achieved.

In the area of electricity, the principles of operation and construction of the miniature electric motor are exactly the same as in the factory manufactured motor with its carefully wound coils and accurately machined parts.

Not all school graphic arts shops can be equipped with the expensive motor driven presses, but certainly the same important knowledges and skills can be experienced with almost the same degree of satisfaction by the hand or pedal operated press. In woodworking, the principles of the

knowledge, habits, attitudes, and insights may be obtained which closely parallel the true industrial experience.

An example of this modified activity is carried on in the weeks Junior High School in Newton, Massachusetts, in a paper-making unit. A model pulp beater has been constructed by the instructor which is about the same size as a school woodworking bench. This beater performs the beating of the materials into pulp in the paper making process. The manner in which the beating is performed and the quality of the result correspond very highly with the results obtained from the large beaters in the industrial paper mills. The only concept which the student lacks after using the model is the concept of size. This omission is of no great consequence, but with the use of visual aids or industrial visits to aid in the beating, all knowledge and concepts of the industry which are important to the pupil at this stage of his life can be achieved.

In the area of electricity, the principles of operation and construction of the miniature electric motor are exactly the same as in the factory manufactured motor with its carefully wound coils and accurately machined parts. Not all school graphic arts shops can be equipped with the expensive motor driven presses, but certainly the same important knowledge and skills can be experienced with almost the same degree of satisfaction by the hand or pedal operated press. In woodworking, the principles of the

multiple cutter surfacing machines can be grasped from work with the small bench jointer. There the cutting principle is no different on the machine than on the hand plane.

Modified experience need in no way detract from the value of the process experience of the student in the industrial-arts shop.

Utilizing vicarious experience in the school shop--

There is no need to omit or neglect important processes because the facilities of the school shop do not permit their actual or modified experience. Through vicarious experience, these processes may be observed and studied and desired learning products may result. Dr. Roy O. Billett^{1/} of Boston University defines vicarious experience as "the interaction of one individual with the results of the first-hand experiences of others."

The vicarious experiencing of the processes may be presented in the form of industrial films, visits, exhibits, demonstration, and through extensive reading in the various industrial areas. If these visits and experiences are carefully planned and if the desired learning products are developed, valuable results toward the educative growth of the pupil will be achieved.

In the past, too many of the industrial-arts shops have neglected this vicarious industrial experience and have

^{1/} Roy O. Billett, Fundamentals of Secondary School Teaching, Houghton Mifflin Company, Boston, Mass., 1940, p. 163.

multiple cutter and feeding machines can be grasped from work with the small bench lathe. There the cutting principle is no different on the machine than on the hand plane. Modified experience need in no way detract from the value of the process experience of the student in the industrial-arts shop.

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concentrated on a few hand and machine skills.

Teaching the processes in line with the objectives of the school--It is expected that the processes will be experienced in two types of school situations; first in the school which has set its goals toward the development of the aims of general education, and secondly, in the school dedicated to specific vocational preparation. In the former school, the exploratory knowledges, skills, habits, attitudes, and ideals which can be derived from the processes will be of paramount importance. In the vocational school, the processes will be analyzed in more detail, a high degree of skill will be developed, and direct preparation for work in the process will be stressed.

This study relates the processes to the secondary school concerned with the aims of general education. Here the exploratory and consumer benefits are of importance to all students.

As the student advances in his industrial-arts courses, there will in many cases be a gradual shifting of emphasis toward the pre-vocational aims or specific student interests. In the junior high school grades, the only pupils concerned with the pre-vocational values are the early school leavers. Their pre-vocational needs should be met in the industrial-arts shop even if it requires considerable departing from the regular course of instruction.

Processes which can be experienced in the school

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Processes which can be experienced in the school

industrial-arts shops--Many processes can be experienced in the secondary school shops. The following list suggests processes which are adaptable to the experiential level of the early adolescent. This list contains a few important processes from all the industries which were reached by the inquiry form. In suggesting these processes, it is not the intention to limit the shop activities to them but to use this process list as a guide in selecting the manipulative activities which best meet the needs of the pupils in the particular situation.

Textile Area: spinning, weaving, dyeing

Paper Area: hand manufacture

Pottery Area: hand manufacture, firing, glazing

Wood and Lumber: sawing, planing, sanding

Plastics Area: finishing, laminating

Metals Area: founding, forging, heat treating, elementary machining

Leather Area: finishing

Paint and Varnish: mixing, thinning, tinting

Glass Area: forming, after-working

Advance study and experience in any of the above processes should be made available to the student who desires to elect industrial-arts courses in the 10th, 11th, and 12th grades. The student who shows interest in a specific industrial area should be allowed to proceed and specialize in it as much as possible. The science laboratory in the

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school should offer assistance to the advanced student who wishes to experiment with the processes. Many hobby skills may be developed by the advanced student to the artisan level. processes which have been omitted from the above

In addition to the processes which have been mentioned, there are some processes which lend themselves to the work of the older or more advanced student. Often the equipment required is more complex and expensive, and previous experience with the common tools and materials are prerequisites for advanced process activities. The following list designates a few processes which lend themselves to advanced study.

Metals Area: machining (planing, milling, turning),
assembling, fabricating, welding

Wood and Lumber: machining (sawing, planing), bonding

Paper Area: finishing

Plastics Area: molding, fabricating

Leather Area: tanning, coloring

The reader will recognize by the names of these processes that they are very extensive in scope and require greater skill and more equipment for their proper functioning. The metal process of machining is so extensive that the student could easily spend the last three years in high school majoring in this one activity and still not exhaust the specialized learning products which could be derived from this process area.

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Many processes which were mentioned in the summary analysis in Chapter II have not been placed on either of these suggested lists to be experienced in the shop. All of the processes which have been omitted from the above lists lend themselves to the vicarious experiences which were discussed earlier in this chapter.

It is hoped that this study has acquainted the reader with the value of the industrial processes and the contributions they can make in helping the pupil understand and use his technological environment.

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- A Unit in Metalworking

Description of the unit and the processes involved--

The three processes of machining, founding, and forging are the basis for the manipulative experiences in the following unit. Through the experiencing of these processes the pupil will be able to grasp the knowledges, skills, attitudes, and ideals, which are the goals of the unit. As the unit progresses the student will be developing goals for himself which will have much in common with the goals of the unit.

The tentative time allotment for the unit is two double periods per week for eighteen weeks. An average of two and one-half periods per week are given over to the manipulative experiences in the general metal shop; the remainder of the time is spent in witnessing demonstrations, industrial visits, moving pictures, discussions, reports, lectures, and in other forms of individual and group activities in the informational center of the shop.

The format of the unit has been adapted from a seventh-grade woodworking unit developed by Herman A. Pohlman, director of industrial-arts, Weeks Junior High School, Newton, Massachusetts^{1/}.

General Statement of the Unit

The learning products sought for each pupil are: (1) the ability to make some useful articles involving the use

^{1/} Roy O. Billett, Fundamentals of Secondary School Teaching, Houghton Mifflin Co., Boston, Mass., 1940, pp. 545-554.

of the common metalworking tools, machines, and materials; (2) an appreciative understanding of the different metals from the consumer's standpoint; (3) an understanding and appreciation of the importance of the metalworking industry in society; and (4) an appreciative understanding of work and workers in relation to the students own work problems now and in the future.

Itemized Statement, or Delimitation of the Unit

The pupils should possess:

1. The ability to handle the following tools correctly and with safety to himself and others: scriber, tin snips, rule, outside calipers, ball-peen hammer, raising hammer, stakes, molds, hacksaw, tongs, forge, grinder, files, soldering iron, bench machine lathe, compound rest, cutting tools, knurling tools, flask, rammer, sprue cutters, and ladle.
2. The ability to handle the following materials with safety to himself and others: octagon tool steel, zinc alloy, sheet copper or brass, steel wool, oil, abrasive papers, patterns, solder, and molding sand.
3. The ability to read simple drawings and design a small tray or dish.
4. In machining, the ability to (a) cut off octagon tool steel to length, (b) locate and drill center holes, (c) adjust the tool holder, (d) start and stop the lathe, (e) adjust lathe dog, (f) turn to

of the common metalworking tools, machines, and materials;
 (2) an appreciative understanding of the different metals
 from the consumer's standpoint; (3) an understanding and
 appreciation of the importance of the metalworking industry
 in society; and (4) an appreciative understanding of work
 and workers in relation to the student's own work problems
 now and in the future.

Itemized Statement, or Delimitation of the Unit

The pupils should possess:

1. The ability to handle the following tools correctly

and with safety to himself and others: scriber, tin
 snips, rule, outside calipers, bell-peen hammer,

raising hammer, stakes, molds, hacksaw, tongs,

large, middle, and small files, soldering iron, bench machine

lathe, compound rest, cutting tools, handwinding tools,

files, rammer, square cutters, and ladle.

2. The ability to handle the following materials with

safety to himself and others: cast iron tool steel,

zinc alloy, sheet copper or brass, steel wool, oil,

abrasive papers, patterns, solder, and molding sand.

3. The ability to read simple drawings and design a

small tray or dish.

4. In mechanics, the ability to (a) cut off excess

tool steel to length, (b) locate and drill center

holes, (c) adjust the tool holder, (d) start and

stop the lathe, (e) adjust the dog, (f) turn to

size, (g) adjust knurling tool and knurl, (h) cut a taper, (i) file and polish, (k) grind and sharpen, and (l) harden and temper.

5. In forging, the ability to (a) cut off octagon tool steel to length, (b) heat in a forge, (c) forge to desired taper, (d) reheat when necessary, (e) draw file tapered surface, (f) grind to cutting edge, (g) grind butt end for hammer, (h) harden and temper, and (i) use the chisel correctly.
6. In founding, the ability to (a) select pattern, (b) prepare sand for molding, (c) ram a mold, (d) place sprue pin and gate, (e) melt the metal, (f) pour the metal, and (g) finish the casting.
7. In art metal, the ability to (a) transfer design to material, (b) cut material to size, (c) saw pattern with jewelers saw, (d) file edges, (e) select stake or mold, (f) shape the metal, (g) apply decoration by etching, sawing, peening, or engraving, and (h) buff and finish.
8. The ability to judge, select, and purchase commodities and articles of metal to be used in the home. These to be judged by such criteria as quality of material, construction, finish, and price. (e.g., tools in the home workshop, metal furniture, household appliances, metal house construction, metal weather stripping, plumbing equipment, autos, metal

ornaments, and fixtures).

9. The ability to care for the above articles and to recognize any malfunctioning.
10. The ability to recognize the dangers inherent in improper handling of metal appliances, and to know the safety precautions to be taken in their care and upkeep. To know the proper persons to call for certain repairs.
11. An understanding of the various branches of the metalworking industry and related industries, such as steel sheet metal, machine trades, foundries, forge plants, metal specialty companies, and metal craft trades, from the following standpoints: (a) contributions of the worker to industry and society; (b) qualifications necessary for beginning experience and future success in the industry; (c) rewards and advantages, financial and otherwise, accruing to the worker in the industry; (d) disadvantages of the occupation.

The Unit Assignment

- A. Introduction: exhibit, lecture, test, shop tour, selection of work areas, pupil personnel organization, and demonstration.
 1. Explain the three-fold nature of the course: (a) to learn to make some useful and interesting

ornaments, and fixtures).

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The Unit Assignment

A. Introduction: exhibit, lecture, test, shop tour;

selection of work areas, pupil personnel organiza-

tion, and demonstration.

1. Explain the three-fold nature of the course: (a)

to learn to make some useful and interesting

- articles from metal with the common metalworking tools; an exhibit of cold chisels, center punches, nail sets, foundry projects, and art metal projects has been prepared to guide the student in his selection; (b) to learn about the metal industries and trades--their importance, products, worker qualifications, advantages, disadvantages, and their services to society (through readings, visual aids, and such films as "Story of Steel," "Aluminum: Fabricating Processes," "Machinist and Toolmaker," and "Steel--Man's Servant"; (c) to learn to buy and care for the products and tools of the metalworking industries with special emphasis placed upon home utilization.
2. Demonstrate the correct use of each tool in the situation in which the pupils will use it.
 3. Give a test of multiple-response and completion questions to discover what the pupils already know about the meanings and insights to be developed.
 4. Hand out the job guide sheets for the area in which the student is working. Distribute the study and activity guides at the beginning of each informational activity. (At the close of the course, the student's notebook will contain a job guide sheet in forging, founding, art metal,

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and machine work. It will also contain study and activity guide sheets on these five areas: the Metalworking Industries, Manufacturing Iron and Steel, The Story of Abrasives, The Story of Metalworking Tools, and Metals in the Home.)

B. Core activities. (All of the items in this section will appear on the various guide sheets.)

1. Forging area

- a. Select the size and type of chisel which you would like to make. Secure the forging job guide sheet and fill in the bill of material form on back of guide sheet.
- b. Get out stock and hacksaw to correct length. (See information guide on Using the Hacksaw.)
- c. Place tongs, hammer, and tool steel near the anvil and light the forge.
- d. Heat one half of chisel to cherry red and forge to the desired shape. You will have to reheat the metal quite often. (See information sheet entitled Forging.)
- e. Ask the instructor to check your work thus far. If it is O.K. secure a 10" single cut mill file from the tool room and draw file the tapered sides. Ask for demonstration of draw filing.
- f. Grind tapered end of chisel to a 60 degree

- point. (See information guide on Grinding a Cold Chisel.) Ask instructor for approval.
- g. Harden and temper the chisel under instructor's supervision. (See information guide on Hardening and Tempering Steel)
- h. Test chisel on scrap of band iron. Grade the chisel with the mark you think it deserves and check work with the instructor.

2. Machine area

- a. Select size and type of center punch or nail set which you wish to make. Secure the machine job guide sheet and fill in the bill of material on the back of the sheet.
- b. Get out stock and hacksaw to correct length. (See information guide on Using the Hacksaw.)
- c. Ask the instructor to demonstrate locating centers and drilling center holes. After demonstration drill the center holes in your stock.
- d. Clamp stock in the lathe dog, white lead the center holes, and position in the lathe. Ask instructor for his approval.
- e. After instructor's demonstration of setting the cutting tool in position and starting the cut, turn stock to maximum outside diameter. (See information guide on Plain Turning.)

- f. Adjust knurling tool and get instructor's O.K.
(See information guide sheet on Knurling.)
Knurl the entire surface of the stock.
- g. Cut taper and shoulders and finish with emery cloth. (See information guide on Taper Turning.)
- h. Hacksaw to finished length and finish tapered end on the grinder for a nail set or prick punch.
- i. Harden and temper the punch under instructor's supervision. (See information sheet on Hardening and Tempering Steel.)
- j. Test the punch on a piece of scrap band iron. Grade your workmanship with the mark you think it deserves and ask the instructor to check your grade.

3. Foundry area

- a. Select the type of foundry project which you wish to make. If you have a small object at home of which you would like to make a casting, bring it to the shop and ask the instructor for his approval of your project. Secure the foundry guide sheet and fill in the bill of material on the back of the sheet.
- b. Closely observe the instructor's demonstration of making a mold. You will be required

to repeat the same steps with your project.

(See information guide sheet on Preparing the Molding Sand.)

- c. Place the drag into position on the molding board and lay pattern in the center.
- d. Riddle the sand for a depth of 1" over the mold and then carefully fill the mold and ram the sand. (See information guide on Ramming the Mold.)
- e. Carefully turn both the drag and molding board over on the bench and smooth the "part".
- f. Locate the sprue pin, place the cope of the flask in position on the drag, riddle the sand over the part, and repeat item "d".
- g. After ramming, lift off the cope, and remove the pattern under the instructor's supervision.
- h. Cut a small gate between the sprue and mold for the passage of the metal and carefully replace the cope in its original position.
- i. Carefully read the information guide on Pouring the Mold. Take all safety precautions. Pour the mold under the instructor's guidance.
- k. After a 20-minute cooling period, open the flask and remove the casting. Finish the

casting with the file, abrading paper, and buffer. Paint if desired.

- k. Grade your workmanship and ask instructor for his final approval.

4. Art Metal area

- a. Select an art metal project which you might like to make from the exhibit of dishes and trays.
- b. Draw a full-size pattern of the dish and the decorating design. Ask instructor for approval of drawing and design before getting out the necessary metal.
- c. Trace the pattern on the metal. Be very careful not to waste material. Cut the metal out with tin snips. (See information guide sheet on Laying Out.)
- d. File all sharp edges and remove any slivers from the metal.
- e. Secure correct mold or stake for your project. (See information guide sheet on Raising and Shaping Art Metal.)
- f. Hammer to shape, annealing as often as necessary. Ask for instructor's approval.
- g. Decorate project as suggested by your design. (See information guide on Chasing and Etching.)
- h. Finish project with fine abrasive or buff on

electric buffer. Lacquer if necessary.

- i. Grade your workmanship and ask instructor for final check.

5. What the metal industry means to us.

- a. Try and describe what it would be like to live in a town where there were no autos, air-planes, stoves, furnaces, or machines. Look through the reference books and write down 25 metal jobs or trades which you consider to be very important and interesting. Would you like to learn more about these jobs? If you are interested ask the instructor or your guidance counselor for special reading material in the particular job area.

- b. From your reading and school shop experience prepare a report to the class concerning one metalworking job.
- c. Read the mimeographed booklet entitled Fields of Metalwork.
- d. Optional activities

- (1) For the bulletin board or your notebook make a collection of pictures of people who are working with metal.
- (2) If your Dad works in a metal trade, write a story or report to the class on the

information which he can give you.

- (3) On a map of the United States, locate with colored pins the areas or centers of the mining and metal industries.
- (4) In addition to the visit which we make to an industrial shop, visit a metal shop or garage near your home and report to the class the important things you learned from your visit.
- (5) If you think you might like to work with metal for a livelihood, consult with your guidance officer about additional educational studies you should take in preparation.

6. Manufacturing iron and steel

- a. Draw for your notebook a picture of a blast furnace or an open hearth furnace. List the major functions of the furnace under your drawing.
- b. You may choose to work in one of the following groups:

- (1) Prepare a demonstration of identifying

7. The different steels and irons with the electric grinder.

- (2) Using the shop electric train and the molding sand, prepare an exhibit of an

open pit mine. Explain your exhibit to the class.

(3) Prepare an exhibit of all the types of iron and steel that you can find. List the properties of each type.

(4) Prepare a bulletin board display of pictures of the steel industry.

c. Optional activities

(1) If none of the groups are interesting to you, you may suggest to the instructor for his approval some individual study which you would like to make.

(2) Write a story of the importance of the coal industry to the steel mills.

(3) Prepare an exhibit of wire drawing. You may use a soft metal such as copper but relate your description to all wire.

(4) Tell the class why the steel mills are located in Pennsylvania and not near the mines in the Lake Superior Region. How is the ore transported to the mills.

Draw the journey on the map.

7. The story of abrasives

a. What is an abrasive? What other abrasives besides emery can you name? Why are some abrasives referred to as natural and others

as artificial?

- b. What is meant by grading the grain? What are the most common bonding materials? Does the speed at which the wheel turns have an important bearing on the choice of bonding material? Why?
- c. What do we mean by offhand and precision grinders? What type is our grinder in the shop?
- d. What are the important safety features to keep in mind when using the grinder? Be very sure that you know and always practice these.
- e. Optional activities
 - (1) Prepare a demonstration of the raw materials which are used in abrasives.
 - (2) Prepare an exhibit showing various grades of paper and cloth abrasives.
 - (3) Prepare a demonstration with different grades of sand and screens to show how abrasive grains are graded for size.

8. The story of metalworking tools

- a. Have you or your Dad a workshop or a set of tools in your house or garage? In what condition do you keep your tools? Would you like to have your instructor visit your shop?
- b. Have you known a skilled tradesman who took

great pride in his tools? How did he select his tools?

- c. The story of tools is as old as the story of man. Man has always been developing tools which will aid him in his work. Because this is such a large subject, we will be divided into four groups. Each group will take a special assignment and report to the class upon its completion. You may choose one of the following four areas: (a) The tools used by primitive man, (b) Today's metalworking tools, (c) Tools for the home workshop, (d) How to care for your tools.
- d. If you are interested in preparing an exhibit of early tools, notify the instructor, as he can advise you on your problem.
- e. Optional activities
- (1) Prepare a bulletin board display on machine and hand tools.
 - (2) Visit the hardware store and inquire into the cost of the tools which you think are necessary in the home workshop. Make a report to the class on your price list.
 - (3) Bring to the class some tool which is broken and you think might be repaired.
- If possible you may work on this yourself

as an extra project.

- (4) With the assistance of your instructor and your English teacher write a short story concerning the need of any new tool in the shop. If you do well with this paper, the instructor will attach your story to the request which he will submit for the tool.

9. Metals in the home

- a. Bring to class a list of all the different uses of metal which you can find in your home. Compare this with the lists of other students.
- b. If there is any instructions for the care of an appliance attached to the device in your home, copy these instructions and bring them to class. We will discuss this in class.
- c. Are there some machines in your home which you had better not tamper with? If these machines go out of order, whom should you call to repair them?
- d. Are your parents contemplating buying some new machine or piece of metal equipment? If they are, collect all pictures, catalogs, and descriptions which you can concerning this or similar machines. Select the one you would buy, paying careful attention to such items as

cost, use, durability, construction, size, appearance, and other qualities which we have discussed in class. You may be of help to your parents in the selection of the article.

e. Optional activities

- (1) Visit the metal appliance stores in your neighborhood and price three or four different makes of washing machines. Carefully analyze the advantages and disadvantages of each machine. Is the most expensive machine the best? Did the salesman show you any disadvantages of the machine? Report to the class the results of your trip.
- (2) You may do the same as number 1 above but use some other appliance which interests you more. You may be interested in an automobile.
- (3) Make a scrapbook of the metal appliances which you would buy if you were just married and were starting housekeeping in a three-room unfurnished apartment.
- (4) Write a story on the importance of metals to the transportation industry.
- (5) Prepare a bulletin board exhibit of metals used in the home.

List of Readings for the Unit in Metalworking

- Becker, William J., Metalworking Made Easy, The Bruce Publishing Co., Milwaukee, Wis. 1942
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APPENDIX

Letter Accompanying the Inquiry Form

50 Vernon Street
 Norwood, Mass.
 January 2, 1946

Dee & Smith Manufacturing Company
 1254 Fifth Street
 New Hastings, Massachusetts

Gentlemen:

Public school education is attempting to present a program of studies designed to meet the needs of the pupils in this present day industrial society. The industrial-arts work in grades 7-12 is attempting to contribute to some of these needs but we as industrial-arts teachers find that our knowledge concerning the major industrial processes is limited. **APPENDIX** Through a co-operative effort with the manufacturers and the broadening of our knowledge will we be able to contribute our part to the pupils' education.

This inquiry sheet is an attempt to obtain industrial opinion and to receive concrete information from the manufacturers concerning the most important industrial processes.

Your reactions are valuable to us and are a necessity in establishing an industrial-arts program which will be valuable to all youth. Your prompt reply to this inquiry will be greatly appreciated.

Very truly yours,

Letter Accompanying the Inquiry Form

80 Vernon Street
Norwood, Mass.
January 2, 1946

Doe & Smith Manufacturing Company
1234 Fifth Street
New Hastings, Massachusetts

Gentlemen:

Public school education is attempting to present a program of studies designed to meet the needs of the pupils in this present day industrial society. The industrial-arts work in grades 7-12 is attempting to contribute to some of these needs but we as industrial-arts teachers find that our knowledge concerning the major industrial processes is limited. Only through a co-operative effort with the manufacturers and the broadening of our knowledge will we be able to contribute our part to the pupils' education.

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Your reactions are valuable to us and are a necessity in establishing an industrial-arts program which will be valuable to all youth. Your prompt reply to this inquiry will be greatly appreciated.

Very truly yours,

INQUIRY CONCERNING THE INDUSTRIAL PROCESSES

PURPOSE: To learn about the importance of the major manufacturing activities in the industry and the importance of these activities in the industrial work program.

DIRECTIONS: Please encircle the letter or word in the right hand margin which best answers the question. If you believe none of the given answers is correct, you will check space under the question for a written statement.

1. The main processes in the industry are _____ industry now

2. The importance of all processes in the above right question seems _____ True False
to be an overestimated value in certain respects.

3. The industry is very modern and orderly _____ True False

4. The industry is connected with the nation's progress and development _____ True False
in a very important way.

5. The processes and operations used in it change now constantly under _____ True False
new conditions.

6. The importance of a process would be very low for the operations _____ True False
in the industry.

7. The importance of the industry seems to have _____ True False
increased in the last few years.

8. The industry is _____ True False
very important.

9. The industry is _____ True False
very important.

10. The industry is _____ True False
very important.

11. The industry is _____ True False
very important.

12. The industry is _____ True False
very important.

13. The industry is _____ True False
very important.

14. The industry is _____ True False
very important.

15. The industry is _____ True False
very important.

16. The industry is _____ True False
very important.

17. The industry is _____ True False
very important.

18. The industry is _____ True False
very important.

INQUIRY CONCERNING THE INDUSTRIAL PROCESSES

PURPOSE: To learn from the industrialist the major manipulative activities in his industry and the importance of these activities in the industrial-arts program.

DIRECTIONS: Please encircle the letter or word in the right hand margin which best answers the question. If you believe none of the given answers is sufficient, you will find space under the question for a written statement.

1. The main processes in the (please name) industry are:

| | |
|---------|---------|
| a. | d. |
| b. | e. |
| c. | f. |

2. Observation of, or experience in the above main processes offers sound basis for an occupational choice in certain job fields. True False

3. Processes are fairly constant and undergo only minor changes. True False

4. Applications of processes change with the manufacture and development of new products. True False

5. The machines and operations used in a process are constantly undergoing changes. True False

6. The first breakdown of a process would be into (a) jobs, (b) operations, (c) a b c

7. Please rank the following items in their 1, 2, 3, order of importance in the qualifications of the beginning worker.

| | | |
|------------------------|-------|--|
| Manipulative skills | () | |
| Industrial information | () | |
| Work habits | () | |

8. An industrial process is:

| | |
|--|---|
| a. A chemical or physical action which brings about a distinct advancement in the material toward practical use. | a |
| b. A single or series of operations which radically change the material. | b |
| c. A broad term used to name a division or trade in an industry. | c |
| d. | |
| | |
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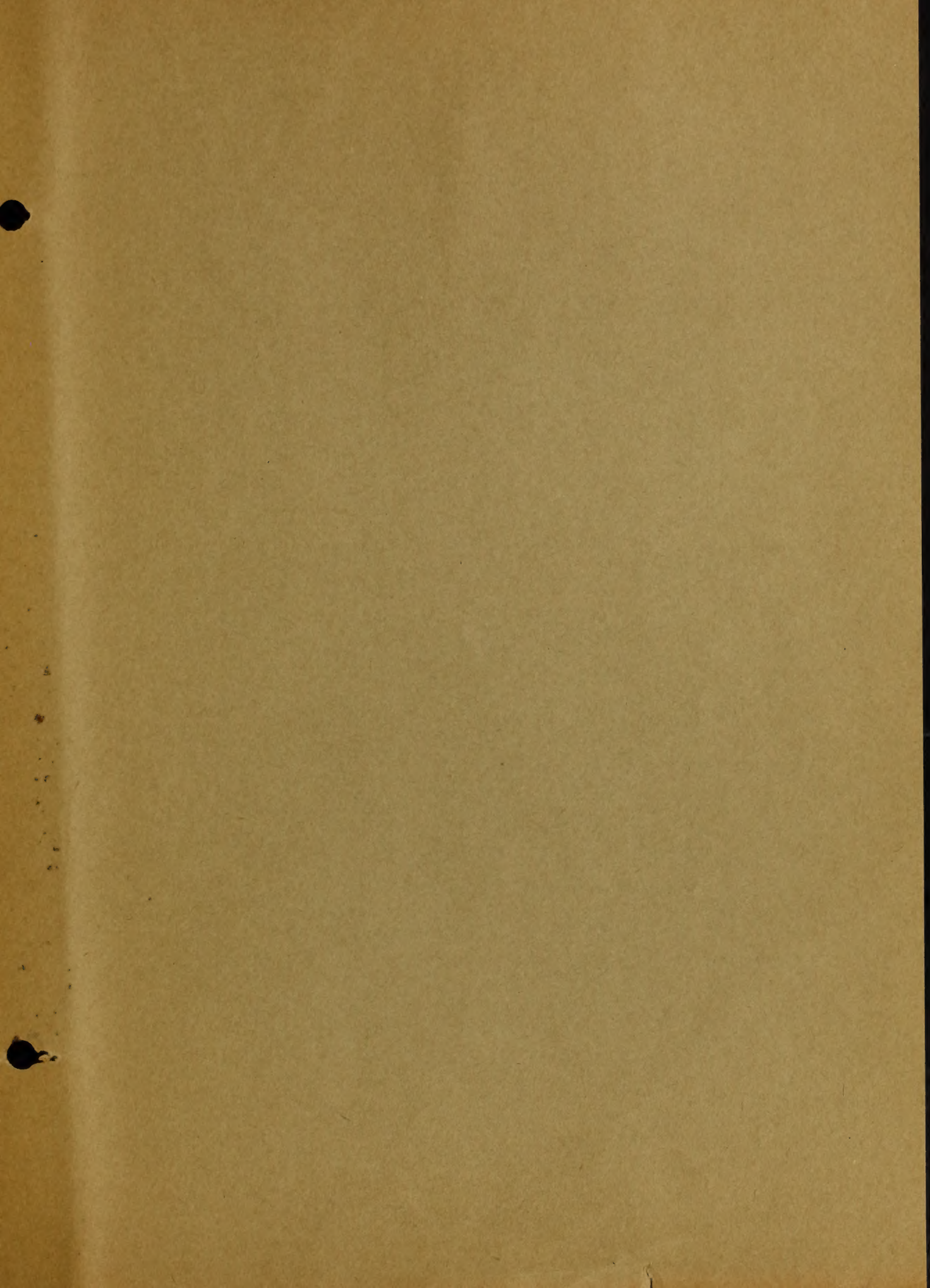
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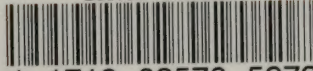


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